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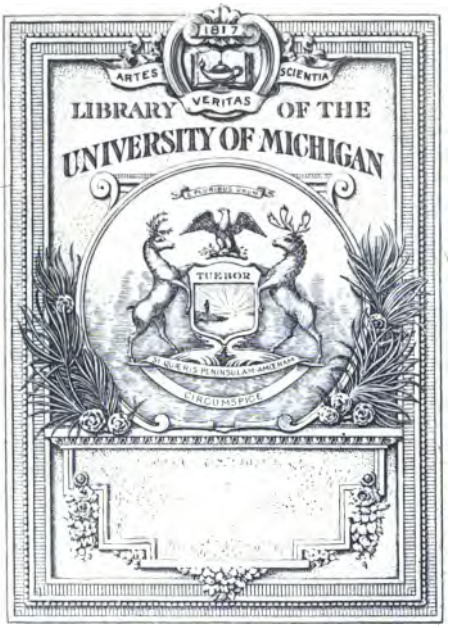
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ON

TECHNICAL INSTRUCTION,

APPOINTED BY

Imperial Decree, 22nd June 1863.

REPORT ON TECHNICAL INSTRUCTION IN GERMANY AND SWITZERLAND,

TOGETHER WITH

DOCUMENTS LAID BEFORE THE COMMISSION.

Presented to both Houses of Parliament by Command of Her Majesty.

France. = Commission de l'enseignement professionnel.

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To His Excellency the Minister of Agriculture and Public Works.

GENERAL REPORT ON THE ORGANIZATION OF INDUSTRIAL EDUCATION IN GERMANY AND SWITZERLAND.

SIR,

THE object of the mission which you confided to us was to collect the most precise information that could be obtained on the organization and actual condition of the professional educational establishments existing in Germany. To comply as completely as possible with your desire to be promptly informed on these questions, we were compelled to confine our investigations to the more important centres of education and manufactures. We flatter ourselves, however, that we have seen enough of them to be able to lay before you a general view of the organization of the instruction intended for workpeople, tradesmen, manufacturers, and engineers of different classes, and to call your attention to the analogies and differences which is displayed in the various countries which we have visited.

We have received from the Governments, heads of establishments, and scientific men, the most cordial aid in the accomplishment of our mission. Everywhere the utmost readiness was shown in supplying us with oral and documentary information calculated to enlighten us. We feel bound to declare this fact, and to make known that, in spite of the political anxiety which at the moment disquieted Germany, the esteem felt for the scientific doctrines of France, the liberality with which she opens her educational institutions to foreigners, as to her own citizens, have established bonds of union and kindly feeling which political questions cannot weaken.

Leaving Paris on the 6th of March, we visited the establishments of professional and industrial education of Elberfeld, Hanover, Brunswick, Berlin, Dresden, Prague, Vienna, Nüremberg, Munich, Zürich, Stuttgart, and Carlsruhe, and returned to Paris on the 16th of April. M. Perdonnet, recalled by the requirements of his office, was obliged to leave us at Vienna, on the 17th

of March. But, on his way home, he visited by himself, Stuttgart, Zürich, and Carlsruhe.

In our Report we will endeavour to group together all the information we have been able to collect on the organization of instruction in one and the same country, so as to enable any one to form a correct notion of the whole system and its arrangement. But as the documents, which are numerous and contain many tables and figures, may require considerable time to peruse and some little study to appreciate the differences and analogies, we have thought that our work would be more easy to read and better adapted for attaining the end proposed, if we first gave a general view of the similar institutions adopted, at the same time calling attention to the varieties they present, and then concluded with deducing the general consequences which seem to result from them.

This rapid statement, by showing the idea of the general system adopted in Germany, will also enable you the more easily to determine what are the means for attaining the same end most in harmony with our habits and institutions.

Primary Instruction.

The basis and starting point of all systems of public education being primary instruction, and, in this respect that of our population being very incomplete, in spite of the great and ever-increasing sacrifices made by the State to extend the benefits of the law of the 21st June 1833, we have felt bound to devote our attention to the manner in which this instruction is organized in Germany, and to the successive additions made to it. We have not forgotten the statements made by several of our chief manufacturers during the inquiry which you held respecting the difficulties they encountered in finding, among their most intelligent workmen, overseers sufficiently conversant with the most elementary branches of primary instruction. On the other hand, the general ignorance of foreign languages in France, is a great drawback to our industry, especially in our relations with other countries, inasmuch as, in certain trades and for correspondence, it is indispensable to obtain from abroad both overseers and counting-house clerks. The literary education given to young men who intend to follow the commercial career ought therefore to engage your attention as well as technical instruction. Such are the motives which have led us to occupy ourselves with these two classes of study, which we regret to see so imperfectly pursued in France; at the same time that we felt bound to examine the organization of the teaching of the applied sciences.

In all the countries we have visited, whatever the form of government or religion, both law and custom make primary instruction compulsory. Nowhere is it admitted that fathers have the right, to the prejudice of society, of withholding from their children this nourishment of the mind, any more than they can deny them that of the body. Laws and formal regulations establish

this compulsion; a special supervision is exercised to ensure its observance, and it is further secured by graduated penalties, consisting in the first instance of an admonition from a magistrate, or a special authority, next of a fine, and lastly of imprisonment.*

These rules are as strictly observed in republican Switzerland as in monarchical Austria. They are everywhere accepted, and few persons ever attempt to evade them without legitimate grounds. But grounds of this kind too commonly exist in the rural districts. The isolated and scattered position of houses, the state of the roads, the mountainous nature of the country, are so many obstacles which necessitate a relaxation of the rule, at least for a time.

Austria.—Thus—taking the Austrian Empire—whilst out of the total number of children of six years old, who ought to attend the primary school, it is really frequented in:

Upper Austria, by	99·2	per cent.
Lower Austria	98·5	„
Styria	84·2	„
Tyrol	100·0	„
Bohemia	95·9	„
Moravia	99·1	„
the proportion diminishes for:		
Hungary, in general, to	55·4	„
Carinthia	71·9	„
Venetia	34·5	„
Croatia	19·8	„

But it is proper to remark that the diffusion of education in this country presents this peculiar feature; the populations composing the Empire speak nineteen different languages or idioms, which renders indispensable, almost everywhere, the teaching of at least two languages: the vernacular first, then the German.

In central Germany and Switzerland the attendance is general and secured by a regular supervision, of which we shall afterwards give instances. But notwithstanding the natural obstacles, or the indifference of some populations remote from centres of intellectual activity, the principle subsists every where; the exception therefore astonishes when it does not present itself as the consequence of evident circumstances. For instance, the colonel of a regiment in one of the minor States of Germany having ascertained that, out of a contingent of 800 men recently sent to him, four individuals could not read, the fact appeared so extraordinary that an inquiry was held in order to ascertain the cause.

Baden.—A proof of the way in which compulsion acts is presented by the commercial statistics of the Grand Duchy of Baden,†

---

* For poor parents whose children are admitted gratuitously, the fine is replaced by so many days' work for the township.

† *Die Gewerbe im Grossherzogthum Baden*, by Dr. R. Dietz (p. 102).

which contain the following facts regarding the offenders condemned to different punishments, that is to say, the very lowest part of the population :—

Out of 100 prisoners there were—	1859.	1860.	1861.	Average.
MEN :				
Able to read and write - -	97·21	97·79	97·38	97·40
Able to read, but not to write -	1·02	0·14	0·13	0·43
Totally illiterate - - -	1·76	2·05	2·47	2·09
WOMEN :				
Able to read and write - -	92·14	94·21	88·17	91·77
Able to read, but not to write -	0·71	1·73	6·29	2·58
Totally illiterate - - -	7·14	4·04	4·72	5·30

It must be acknowledged, however, that, notwithstanding the provisions of the law, and without special circumstances to justify its non-observance, there are in some States very great inequalities and irregularities in the actual attendance at the primary schools. This is especially made manifest for Austria, as we have just stated, and as will be seen in the Report on the Austrian schools addressed, in 1862, to Chevalier von Schmerling, Minister of State.* We give at length, in the part of our Report which especially concerns Austria, the curious statistical results contained in those returns.

But if attendance at school is secured by the enforcement of the law, the question still remains whether the result obtained really meets the wants of the country, and what is the proportion of young persons able to read and write as compared with the total number of the same age. Our information on this point is not so complete as we could wish ; however, we may cite some rather characteristic results.

Bavaria.—In Bavaria, among the young recruits who joined the army in 1864, the number of those who could read and write but imperfectly, or could only read, was on the average eight per cent.

Prussia.—In Prussia, the proportion of children from 5 to 12 or 14 years of age who really attend the primary schools to those who ought to do so is:—

978 per thousand for boys ;
971 per thousand for girls.

The average would therefore be 974 who, out of every 1,000, attend the schools, which, for 3,900,000 children of the age stated, would correspond to an attendance of 3,798,600, and to the

* *Bericht uber die Austellung von Schul und Unterrichtsgegenständen in Wien*, 1862.

absence of 101,400 children, and not of 600,000, as the Minister of Public Instruction conceives. On the other hand, the statistics of recruitment for the army show that, out of 1,000 recruits joining the regiments, there are only 30 unable to read and write.*

Saxony.—In Saxony, the number of children from 6 to 14 years of age who ought to attend the primary schools is 370,802
The schools are really attended by - - 371,980

Difference in excess - 1,178

This excess of attendance is attributed to the fact that a certain number of children go to school before they are six years of age, and that others remain after fourteen. There are also a rather considerable number of foreign pupils, attracted by the reputation of the Saxon schools. In a statistical work on Saxony, Dr. E. Engel gives the following results as to the recruits joining the army :—

Years.	Number of Men per 1,000		
	Able to read and write.	Able to read only.	Totally illiterate.
1847 - - -	957	23	19
1848 - - -	967	20	13
1851 - - -	960	17	16
1852 - - -	966	16	18

Results of Primary Instruction in France.

If we compare the results obtained in Germany with those which are every year carefully ascertained and collected by the Ministry of War, we are compelled to acknowledge the great inferiority of our population in this respect, and the slow progress of primary instruction in France.

The following table contains :—

1. The numbers of young men of 20 in all France who drew for the conscription, that is the whole of the young men of that age in the empire;

2. The number of those who could neither read and write ;

3. Lastly, the proportion of this last number to the first from 1828 to 1862 inclusively, that is, for a period of 35 years, in which are comprised the 29 years elapsed since the enactment of the law of 1833, which may have begun to produce its effects on the men of that age from 1845 or 1846, or for about sixteen years.

* See the special report on Prussia (p. 57).

Years.	Total of Young Men who drew for the Conscription.	Number of Young Men unable to read or write.	Number per Thousand of Young Men unable to read or write.
1828	282,985	149,824	530
1829	294,975	153,685	521
1830	294,593	146,502	496
1831	295,978	143,752	488
1832	277,477	131,353	474
1833	285,805	131,011	458
1834	326,298	149,195	457
1835	309,376	139,585	450
1836	309,516	136,294	440
1837	294,621	128,127	435
1838	287,311	120,436	419
1839	314,521	130,434	414
1840	300,717	125,760	418
1841	300,822	121,698	406
1842	304,222	122,058	401
1843	304,998	118,790	387
1844	308,900	117,879	382
1845	300,775	111,382	370
1846	307,091	109,038	356
1847	304,905	106,443	348
1848	305,124	106,138	348
1849	304,023	106,279	350
1850	305,712	104,995	344
1851	311,218	105,900	341
1852	295,762	98,671	335
1853	301,295	99,548	330
1854	306,622	99,600	324
1855	317,855	102,495	321
1856	310,289	97,875	317
1857	294,761	90,373	306
1858	305,330	92,579	302
1859	306,314	80,878	266
1860	312,204	90,781	293
1861	321,435	90,942	283
1862	323,070	88,796	274

On examination, this last column shows :—

1. That out of 1,000 young men aged 20 in 1828, that is, who were born in 1808, in the midst of our great wars, there were 530, or more than half, unable to read and write.

2. That out of the same number born in 1813, who, in 1833, when the law on primary instruction was promulgated, were 20 years of age, there were still 458, or nearly half, equally untaught.

3. That after 29 years' operation of this beneficent and popular law, notwithstanding the ever-increasing sacrifices of the Government (the sum of 100,000 francs voted for popular education in 1829, had increased in 1848 to 3,700,000 francs, and in 1861 to 4,797,000 francs), there are still 274 out of a thousand, or more than one-fourth, who cannot read or write.

The table also shows how slowly, so slowly as almost to induce despair, the diminution takes place in the number of young men unable to read and write, notwithstanding the increased resources

which the parishes (*communes*), the departments, and the Government constantly devote to this fundamental part of public instruction. We see, in fact, that, whilst the sum appropriated by the State for primary instruction has been raised from 100,000 francs, its amount in 1829, to 4,797,000 francs in 1862, that is to say, 48 times more, and while the sums expended by the townships have increased in a far greater proportion, the number of men of 20 years old who can neither read nor write has only decreased from 530 to 274 per 1,000, or less than half. This decrease even seems to become slower and slower in spite of the inverse increase of the pecuniary sacrifices, and it would even appear that so long as no more efficacious measures shall be taken than votes of money and founding of new schools, we cannot hope to see this proportion descend only to that of 10 illiterate individuals out of 100 men aged 20 in less than 50 years.

We are not called in this Report to discuss the means to be adopted in order to obtain this very desirable result, that every man called by the laws to enjoy the rights of citizenship and to fulfil its duties shall be at least able to read and write. But we cannot help expressing the deep conviction that the progress of morality and of civilization, and the pecuniary sacrifices of the State will not of themselves suffice to attain this end. The trustworthy information which we have collected in Germany shows us, on the contrary, that in the countries where the laws make primary instruction obligatory for all, and where a paternal but strict supervision, rather than penalties enacted but seldom applied, assures the execution of those laws, the principle has so completely passed into the habits of the people that scarcely any one thinks of evasion. After about 30 years or less, since the enactment of these laws, every man of 20 in Germany can read and write, whereas, in France, all the money expended, during the same lapse of time, has only resulted in diminishing the number of the untaught by less than one-half.

When a firm determination is taken, there is not so much difficulty as might be supposed in obliging even all the children of a parish (*commune*) to attend the classes of the primary school. The municipal and ecclesiastical authorities, and the landowners can exercise a very great influence towards securing this result. Legal constraint for so justifiable a reason is readily accepted in even those countries which are least prepared for it. For instance, when Prussia, in virtue of the treaties of 1815, took possession of the duchy of Posen, then containing 1,000,000 of inhabitants, with not so many as 20 primary schools, the Prussian Government introduced compulsory attendance at the schools, and met with no difficulty. It was the same, even, in the Rhenish provinces, which then passed from the rule of France to that of Prussia. If our manners and the national character are opposed to legal coercion, there are other means which might at least accelerate progress, but, as we have already remarked, it is not our present business to indicate them; we must content ourselves with supplying the data we have collected on this important question, so closely allied with that of professional and industrial education.

Elementary Instruction in Drawing.

The programmes of the primary schools, besides religion, reading, writing, the elements of arithmetic, the rudiments of history and geography, comprise nearly everywhere, both for boys and girls, the study of freehand drawing, as a preparation for further teaching.

Expenses.

The expenses of the primary schools are, as a general rule, defrayed by the parishes, but the Government aids the poorer localities. The school fees, always very low, are only required of those who have sufficient means; the poor are admitted gratuitously.

Apprentices.

In a great part of Germany trade corporations still exist, but with very limited rights. Apprenticeships are under regulations, and cannot be regarded as terminated till after examinations in which persons unconnected with the corporation generally take part. Among the obligations incumbent on apprentices we nearly everywhere find that of attending, from 16 to 18 years of age, the lessons given on Sundays and holidays, and even in some cases evening classes, which are held at the primary schools.

These lessons, which are intended to improve the instruction which the young people have received, by giving it further development, are not only a very useful, but, as we think, an indispensable supplement of the studies of the primary schools. They very nearly correspond to what the law of 1833 prescribed for our schools under the name of superior primary instruction. They also offer the great advantage of preventing youth from forgetting what they have learned at the primary school, of familiarizing them completely with the elementary knowledge there acquired, at the same time that they enable backward boys to recover lost time. The excuses, more or less valid, which are made to explain absence from the primary school on working days cannot be available on Sundays. The obligation to attend them is enforced by disciplinary measures similar to those adopted for the elementary schools, and in some countries the masters are made responsible for the attendance of their apprentices at the Sunday lessons.

At Carlsruhe there are also classes in the morning before the working hours begin. Attendance at these is compulsory till 17 years of age. Full particulars on this subject will be found in the special Report on the Grand Duchy of Baden.

Although there are considerable differences between one country and another, this obligation to attend the Sunday schools is generally imposed on the ex-pupils of the primary schools till 16 or 18 years of age. It has the result of improving their acquaintance with their first studies, of giving them some instruction in drawing, geometry, commercial arithmetic, and what-

ever concerns the principal trades that may be practised in the district. This instruction is gratuitous, and given at the expense of the parishes.

Children employed in Factories.

The employment of children in factories is, as is well known, on the one hand a necessity, on the other one of the greatest obstacles to the physical, intellectual, and moral development of the working population. The Commission has received some distressing information on this point, and it has also heard from many manufacturers and from the Industrial Society of Mulhouse, the expression of a determination, both honourable and philanthropic, that, in order to prevent the rising generation from being brought up ignorant, the work of children and apprentices shall be limited to six hours per day, the rest of their time being devoted to education and the recreations suitable to their years.

Since 1837 the Prussian Government, in the threefold interest of society, of the education and the morals of youth, has constantly enforced efficacious measures. According to the last regulations (16th May 1853):

"Children cannot be allowed to work in factories under the "age of 12.*

"From and after 1st October 1853 young people under 16 "years of age cannot be admitted to work in factories until their "father or guardian presents a certificate stating that they can "read and write. The manufacturer must keep this certificate "and produce it when required by the authorities.

"Children under 14 years of age cannot be allowed to work "more than six hours a day. Three hours a day shall be devoted "to instruction.

"It is strictly forbidden to allow children under 16 years of "age to work before half-past five in the morning, or after "eight in the evening."

Graduated penalties, increasing for each repetition of the offence, punish the infraction of these rules for the protection of childhood, and even, in case of three convictions within the space of five years, the magistrate is empowered to interdict for a given time the employment of children in a factory.

This suspension is compulsory if there be six infractions of the regulation within the same space of five years.

The Government appoints inspectors to watch over the execution of this regulation, which was signed by the King on the 18th of August 1853.

Other articles provide for the supervision of manufactories with regard to health and morals, enforce the separation of girls under 16 from men and boys, and order separate sleeping rooms for each sex.

With a view to maintaining the paternal authority, it is ordered that children's wages shall be paid to their parents.

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* See the special Report on Prussia (p. 57).

The inspectors have also to ascertain that the kind of work, and the substances handled are not injurious to the health of the children.

Finally, care is to be taken that all workshops where dust, etc., is generated, shall be properly ventilated.

We have here mentioned these provisions, which will be further detailed in the special report on Prussia, because they show how wisely and paternally the Prussian Government has acted in all matters affecting childhood and youth.

The Austrian and the Saxon governments have been equally vigilant on this point. (See the special reports on Austria and Saxony).

Apprentice Schools.—(*Écoles d'apprentissage.*)

Besides the schools intended to improve the education which apprentices have received at the primary schools, by teaching them the rudiments of the sciences and of drawing which may be useful to them, there have been established in some parts of Germany, but not in any great number, special schools intended to train or improve workmen in various trades. Some are permanent, others temporary, merely for the purpose of introducing new trades into certain countries. When this end has been attained the school, being no longer necessary, is suppressed. We shall have to mention several instances of this kind, especially in the Grand Duchy of Baden.

The state of the populations has most frequently been the determining cause of these institutions, which have been founded chiefly in the poorest and most densely populated states. Thus, in Silesia, where great poverty prevailed, the Prussian Government has succeeded by these means in introducing the manufacture of Turkish carpets and also lacemaking, which have become an important resource for the country and have given rise to a considerable trade.

In the Grand Duchy of Baden,* schools of this description, called *Industrie-Schulen*, have been founded for the purpose of reviving the clock and watch making trade, which was in a declining state, and for improving the manufacture of straw plait for hats; also for painting on enamel, porcelain, and earthenware. Results no less favourable have been obtained in Belgium, and in the province of West Flanders, where the nuisance of mendicity has been totally abated by the organization of sixty communal weaving schools. At Elberfeld in Prussia, at Stuttgart in Würtemberg, permanent weaving schools have been founded, for the purpose of teaching young men the complete theory of that industry, the composition and decomposition of designs, the transferring of patterns to cards, the making ready, and working of looms. The one at Elberfeld appears to be intended rather† for the instruction of the sons of the manufacturers of the town and teaching

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* See special Report on the Grand Duchy of Baden (pp. 189 and 193).

† See special Report on Prussia (p. 58).

them the general principles of the manufacture, than for improving workmen already taught. Though the young men trained there receive a tolerably complete theoretical instruction, the results appear to us trifling in proportion to the expense.

The second school of this kind established at Stuttgart, receives only, as will be seen in the part of this Report relating to Würtemberg, workmen already trained, who have followed with success the classes for apprentices, and especially those of drawing. They are selected from among the most intelligent and most industrious practical weavers. The theoretical instruction given is combined with actual work at the loom, which they are bound to continue and practise six hours daily to meet their expenses; when they have thoroughly acquired the theory of weaving, in all its details and applications, they are sent abroad with a grant of money to work in the best factories and for the sake of improvement. On returning to their own country they make competent overseers in workshops and factories.

It is evident from these instances, that in certain cases, and for temporary or permanent objects, apprentice workshops may be useful. Nor should it be forgotten that in 1810 a workshop for spinning cotton, temporarily installed in the Conservatory of Arts and Trades, helped to train a considerable number of workmen, who afterwards spread that now important industry throughout the country.

Improvement Schools for Young Men.—(*Fortbildungs Schulen*).

Under this designation there exist in Germany certain institutions, all having for their object, though differing in form, the professional training (properly so called) of workmen. Foremost among the things taught in these schools or classes, which are held on Sundays or evenings, always stands freehand and linear drawing. In some countries, as in Würtemberg and Bavaria (Nüremberg), drawing is the especial object of these schools, and the impulse it has given to all the industries requiring that art are sufficiently striking, and so generally recognized as to render evident the usefulness and necessity of this branch of instruction.

A glance at the immense variety of children's toys with which Nüremberg supplies the whole world, will suffice to show the progress due to this diffusion of the art of drawing. The very smallest figures, whether men or animals, are all produced with almost artistic forms, and yet all these articles are made in the cottages of the mountainous districts of the country. They find employment for the whole population, from children of tender age, as soon as they can handle a knife, to their parents, and this home manufacture, which does not interfere with field work, contributes greatly to the prosperity of a country naturally poor and sterile. Our Parisian manufacturers of toys and fancy articles are still, in this respect, undeniably inferior to their Nüremberg rivals.

In a higher style of work, the art of sculpturing wood, ivory, and stone, has become more diffused, and at the same time more artistic, at least as regards execution. The taste of the compo-

sitions is certainly not absolutely perfect, as we have heard justly remarked in France, because the public exercises great influence on the works of the artists.

However this may be, the communal drawing schools established in so many places, and subjected to a general management as active and intelligent as that in Würtemberg and the Grand Duchy of Baden, and the Sunday and evening schools for apprentices and workmen in the rest of Germany, have resulted in a very remarkable improvement among German artisans, both as regards artistic and linear drawing and in the practical work of different trades. This ought to become for France, in the interest of her industry, a subject of serious reflection. The superior drawing school of Nüremberg,* whose director has laid down the rule that, to make clever industrial draughtsmen, the students must pass through all the classes of artistic drawing, has exercised a very happy influence on the industry of the surrounding districts. To this establishment are sent for improvement the most distinguished pupils of the lower schools, that they may return home and there propagate the knowledge they have acquired. This result, well known to all in Germany who take an interest in these questions, proves the utility of a normal school for training teachers in drawing, especially with a view to industrial art, an institution of which our artists have advocated the foundation for more than 12 years past.

Most of the other schools for improving the education of the working classes, though devoting much attention to drawing, have chiefly had in view its application to the different trades of masons, carpenters, joiners, locksmiths, mechanics, &c. Each pupil has to execute designs relating to his own trade, and is also instructed and practised in arithmetic, geometry, &c. These classes are generally held on Sundays and evenings in the buildings appropriated for schools of a higher order, in which instruction is given during the day, and of which we shall speak further on under the name of trade schools (*Gewerbeschulen*) in Prussia, and of practical schools (*Realschulen*) in Austria. We give the programmes of the different institutions of this kind in the special reports on the various states which we visited.

Similar Schools in Austria.

The end proposed by the schools called *Fortbildungschulen* or *Handwerkerschulen* is equally attained in Austria by those which in that country are called trade schools (*Gewerbeschulen*), and which are attached to establishments of a rather higher order. In that empire these schools are of rather recent date, and have been chiefly founded by industrial societies, whose members, nearly all manufacturers, have imposed on themselves the condition of obliging their young workmen to attend the classes during their last year of apprenticeship, and have moreover

* See special Report on Bavaria (p. 143).

engaged to pay a certain annual sum even when they have no apprentices.

The pupils are divided into an elementary class and special sections. In the first they are improved in reading, arithmetic, writing, and above all in drawing: in the special sections they study and draw subjects connected with their profession. For instance, at the Gumpendorf school, in Vienna, the teaching includes whatever is useful to weavers, silk-workers, ribbon-weavers, trimming makers, dyers, &c. In the school of the Wieden suburb the lessons relate to machinery, and things necessary for turners, joiners, binders, chasers, founders, &c. At another school in the same suburb all the details relating to the building art are taught.

Voluntary Associations of Workmen.

Besides the schools and the special classes for the instruction of workmen, there have been founded, in various parts of Germany, particularly in 1848, associations of working men of which the ostensible and hitherto real object, at least in appearance, is to supply the members with various means of increasing their knowledge, improving their position, and in some instances of rendering each other mutual aid. But in some countries, as Hanover and Prussia, for instance, these societies have not been content with remaining purely local, but have been affiliated to each other, and, under the pretext of meetings for instruction, some of them, from the very nature of the subjects treated by them, have become associations for the discussion, not of political matters as yet, but of questions relating to social organization, which may tend to act injuriously to the working classes themselves. We have been present at the meetings of several societies of this kind, and though we neither saw nor heard anything blameworthy, we think some of them have a fault in their organization which may prove dangerous in times of disturbance.* Thus, the Berlin society, called the *Handwerker Verein*, composed of 3,000 members, presents at once an instance of the value of such associations, and of the necessity of exercising a vigilant control over their tendencies and over the questions treated by the professors. Every evening, from eight to ten, and on Sundays from eight in the morning till four in the afternoon, lessons are given on geometry, algebra, freehand drawing, designs for buildings and machinery, descriptive geometry, perspective, commercial accounts, stenography, caligraphy, the French and English languages, correspondence, and geography. To the courses of lessons, which are well attended, are added more general lectures, and during the months of January, February, and March 1864, besides lectures on natural history, chemistry, technology, ornamentation, the use of tobacco, music, historical subjects were also treated, such as the life of Washington, Lessing, Ulrich von Hutten, Don Carlos,

* See the special Report on Hanover (p. 84).

and political questions which seem scarcely adapted for such an audience. Among these last we may mention, for the first quarter of 1864, the History and Diplomatic Relations of different States, the Present Situation of Russia, Social Economy, the Constitution, the Science of Government, and a great many other matters more or less political. If subjects of this kind were treated injudiciously before the members of an association having a very characteristic flag, ornamented with the well known hand-in-hand symbol, and representing a working man with bare arms, giving one hand to a young soldier and the other to a citizen, it is easy to see that the result might be a moral agitation not absolutely harmless in a city like Berlin. Lastly, we may add that, in spite of their abstention, compulsory for the present, from all political discussion, the reports and speeches delivered at the yearly meetings of the societies too plainly display the desire to treat of politics whenever a favourable occasion shall offer. This fact might be easily demonstrated by an examination of the report of the workmen's association of the Alexander Strasse, issued in June 1863. But, after pointing out the defects of some of these institutions, it is just to acknowledge that all these societies may contribute, and do really contribute, to advance the education of those among their members who have the will to study. Classes for drawing, arithmetic, the elements of science, besides special lessons, and discussions on the progress of science, arts, and manufactures, are the most frequent subjects of the meetings. The members have also the use of libraries where books can be read and even, on certain conditions, borrowed, for reading at home. Moreover the habit of meeting and observing the rules of good conduct and of reciprocal attention and the presence of distinguished professors and of public officers, who show their liking and esteem for the working classes, and that consideration which ought always to be felt for the honest workman, and which is so flattering to him, cannot fail to inspire respect for themselves and for the law, and to train them in habits of order and moderation. In fact it is not rare to see deposits in savings' banks increased, greater economy exercised, and more comfort developed by attending these meetings. Provided they avoid all affiliation of one to another, and entrust the management of them to men known both for their devotedness to the working classes and for their sound political principles, such associations may be with benefit increased in number.

Upper Middle-class Schools (*Höhere Bürgerschulen*).

After showing the general organization of primary instruction and that destined for apprentices and workmen, it will be right to notice the different kinds of schools intended for traders and manufacturers. The lowest of this kind of schools is that commonly known under name of upper middle-class schools, to which are sent, on leaving the primary schools, the children destined by their parents for trade or second-rate manufactures. These are in reality only a higher kind of primary schools. In Austria, for

instance, they form part of the primary instruction, which comprises :* 1. The lower elementary schools, having three classes ; 2. The higher elementary schools, having four classes ; 3. The middle-class schools, having six or seven classes. The last are often so constituted as to comprise all the primary curriculum of the first two, and a course of instruction which is given in the three lower classes of the practical schools, of which we shall speak farther on.

Religion, the German language, French, commercial arithmetic, history, geography, notions of natural history and physics, freehand and linear drawing, caligraphy, are the most usual branches of this education,—one intended rather for petty tradesmen than for manufacturers. Sometimes, however, they are supplemented by others especially applicable to local industries, principally by the aid of drawings. In Austria, these establishments, which are parochial, exist in nearly all towns of 7,000 to 9,000 souls. The attendance is in no way compulsory, and dispenses with that of the Sunday schools. All the pupils are out-door, in accordance with the general usage throughout Germany. It will be seen that these institutions of an inferior order very closely resemble the small private schools which exist in France, and that they have in general but little connexion with industrial teaching properly so called.

Trade Schools (*Gewerbeschulen*).

This title has not the same meaning in all parts of Germany. In Prussia it is applied, according to a circular dated 23d June 1850, under the name of *Provinzial Gewerbeschule*, to establishments which impart technical instruction to masters or foremen, workmen, carpenters, masons, mining overseers, brewers, tanners, distillers, dyers, overlookers in factories, &c. And the ministerial instructions consequently recommend that the teaching shall be directed principally with a view to application.

The pupils who leave the middle-class schools or those for the improvement of workmen may attend the classes if they possess sufficient knowledge of the German language, the elements of arithmetic, plane geometry, and the rudiments of drawing. The subjects taught comprise elementary geometry and part of descriptive geometry, algebra to equations of the second degree, trigonometry, the applications of geometry to land-surveying, the cutting of stone, the study of the fundamental notions of mechanics, mechanical technology, the details of various constructions, the elements of physics and of chemistry with manipulations, &c. The drawings are varied and numerous, and nearly all of a practical tendency.

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* See special Report on Austria (p. 91).

There are in Prussia 25 industrial schools of this kind, situated as follows :—

Rhenish provinces - -	7
Westphalia - - -	5
Silesia - - - -	3
Prussia proper - - -	3
Pomerania - - -	2
Brandeburg - - -	2
Posen - - - -	3
Total -	25

The number of pupils, all out-door, was, in the year 1863,* 1,327, and the average expense of each pupil was 197 francs 80 cents., without rent for buildings or furniture, which are found by the towns. Of this sum the grants from the State amounted to about one-third, and the fees paid by the pupils to one-fourth. This expenditure, for instruction, which though of value is of an inferior order, appears to us excessive. The reason is that these schools are too numerous, so that, with the exception of those in the principal towns, they have not a sufficient number of pupils.

In the organization of these establishments, as of some others to be mentioned hereafter, the liberality of the towns and of the Government has exceeded the wants of the population. No doubt their good effect will be felt, but it would perhaps have been better to proceed at a more sober pace in this path of progress : the success of educational establishments greatly depends on the number of pupils, which ought to be large enough to stimulate the emulation and support the zeal of the teachers.

The premises occupied by these trade schools, of which we have just spoken, are also used on evenings and Sundays, for the classes intended for the improvement of apprentices and workmen, already mentioned under the name of *Fortbildungschulen* or *Handwerkerschulen*. This arrangement is prescribed by the regulations, and the professors of the trade schools are bound to lend their aid. This arrangement has the advantage of utilizing the same staff, as well as the same buildings and apparatus, for two similar kinds of instruction, though of different degrees. The out-door system renders this double employment possible.

The provincial schools, which impose a three years' course of study, and are known in Prussia under the name of superior provincial schools, have the right to hold examinations of outgoing pupils, and of granting certificates of mature studies which entitle their recipients to enter the polytechnic institutes, of which we shall treat hereafter, and wherein the technical instruction is completed.

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* See the special Report on Prussia (p. 64).

Analogous Schools in Austria.

Under a different designation, that of Practical Schools (*Real Schulen*), there is an almost identical organization in Austria.* In fact, in that empire the practical schools form part of what is called middle instruction (*Mittel Schulen*). They are divided into inferior practical schools comprising three years of study, and superior practical schools with a course of six years. Their object, as defined in a decree dated March 2, 1851, is to give pupils, in addition to a general education not embracing the dead languages, an intermediate degree of instruction which fits them for industrial occupations or to enter the technical schools.

The studies of the first three classes, which constitute the inferior school, enable the pupils who have attended them assiduously to enter on the practice of the industrial arts. Drawing from real models, elementary geometry, projections, and their applications to masonry, carpentry, joinery, machines, and, in general to all that concerns construction, form the basis of the studies. In the three higher classes, the study of mathematics and their applications are continued, and comprise descriptive geometry, perspective, &c. The teaching becomes more scientific, though always simple in the methods employed. Besides these studies, which prepare young men for the technical professions, the compulsory course includes :—Religion, the study of one other language in addition to the vernacular, history, geography, natural history, the elements of physics and of chemistry ; to these are added, as optional, the study of living languages, singing, &c. A glance at the tables of the number of hours' lessons in the superior practical school of Prague † will show the attention paid to religious instruction, to the study of the mother-tongue, and to freehand drawing.

Among the different schools of this kind which we visited in Austria, the Prague school is certainly that in which linear drawing is most perfect, owing to the correctness of hand which the pupils have acquired by the preparatory practice of freehand drawing. The teaching of drawing is almost everywhere accompanied by that of modelling, and often by sculpturing in wood and stone. The studies of the practical schools in Austria give the right of admission to the Polytechnic School to those pupils who, after successfully passing the examination for certificates of maturity, desire to acquire a higher degree of instruction. To these practical schools are attached, and given on the same premises and by the same professors, the courses intended for workmen, and called in Austria *Gewerbeschulen*, just the same as in Prussia.

Observations on the Preceding Schools.

It will be seen that the trade schools of Prussia, and the superior practical schools of Austria, both of which propose, by the in-

* See the special Report on Austria (p. 104).
† See special Report on Austria (p. 107).

struction they give to prepare pupils for the polytechnic institutions, where young men are trained for the professions of engineer, architect, chemist, and various branches of the public service, are for the most part organized with a view to teaching the sciences and their applications, whilst the study of literature is only cultivated to a very limited extent. We have particularly pointed out, in the Report on Bavaria, the inconveniences to which this too exclusively scientific preparation of engineers and manufacturers is subject, and we feel bound to direct attention to the necessity of giving a larger share to literary studies, if it be wished that the pupils trained in these schools should afterwards be able to compete with those sent to the polytechnic institutes by the gymnasia, where classical studies are followed.

Practical Schools (*Real Schulen*).

The establishments known under this name are spread over all Germany; but here again, under one and the same title, are often confounded two very different organizations, the types of which are found, one in Prussia the other in Austria.

In the former State the practical school is at present a secondary establishment of literary and scientific education, analogous in many respects to the scientific division of our lycées, with this difference, that the living languages are there taught with greater care and success than in France.

We have seen above that in Austria the practical schools are establishments of elementary instruction in the sciences and in drawing applied to industry, and where the lower classes educate young men intended to become foremen or masters in the various constructive arts, whilst the higher classes enable the pupils to follow the studies of the polytechnic institutes. We need not, therefore, speak of this kind of establishments so far as Austria is concerned.

General Organization of the Practical Schools in Prussia.

The creation of these schools is already of distant date, for that of Elberfield was founded in 1829 by the municipal council of that town, with the authorization of the Government, which placed it under the supervision of the Düsseldorf regency. All the schools of this kind existing in Prussia are under the general direction of the Ministry of Public Instruction, because they are establishments for literary and scientific education, without any technical character. At the time of their foundation the attempt was indeed made to give them this last character, but experience soon proved that the instruction could not be at the same time both sufficiently scientific and sufficiently technical.

At present the practical schools in Prussia are divided into two categories, viz., the lower schools, which have only three or four classes, and the upper schools, which have six or eight, including the preceding amongst them. Boys are admitted at from seven to nine years of age, when they have acquired the first rudiments

taught in the primary schools, so that a young man cannot have completed his studies in the superior practical school before his seventeenth or eighteenth year.

The literary studies of living languages are very extensive, and comprise, in the higher classes, the works of the German poets and prose writers, and for Latin the prose writers only. Some idea may be given of the thoroughness of these studies in the Elberfield school, for instance, by citing some of the subjects of composition treated by the pupils of the first class in 1861–63. *In French.*—Analysis of Corneille's Cid; modern inventions; analysis of the tragedy of Esther; comparison between Cæsar and Napoleon, &c. *In English.*—On the war raging in the United States; Frederick the Great; on the death of Cæsar; Othello, &c. We have had positive proof that the same pupils of this school at Elberfield were able to converse and to translate or analyse a German work in either of those languages. The study of Latin, which, as we have stated, extends only to the prose writers, nevertheless enables the pupils to follow certain courses of the universities to which they can be admitted, like those of the gymnasia, for branches of special study.

As for the scientific instruction it prepares pupils sufficiently, by the first three or four classes, for the industrial schools of the country, and by the higher classes for the studies of the polytechnic institutes. It will be observed that in the latter respect this organization closely resembles that of the scientific division in our lycées.

To give a clear notion of this education we will extract from the special Report on Prussia the following table, which shows the number of hours' lessons devoted weekly to the different branches in the six classes of the practical school at Elberfield :—

Branches taught.		Number of hours' Lessons per Week.
Religious instruction		12
Languages	German	16
	Latin	34
	French	32
	English	9
Geography		8
History		11
Natural History		8
Caligraphy		7
Arithmetic and commercial accounts		19
Physics		6
Chemistry		4
Geometry		11
Singing		7
Gymnastics		12

In this general statement the absence of the study of drawing will be remarked. It is a sad omission, especially in an establishment intended for youth who will follow industrial occupations; but this neglect of drawing is not general in the practical schools of Prussia.

It is worthy of note that the majority of the pupils in these practical schools go away after the third or fourth year, either to attend the inferior technical schools or the industrial schools, in order to enter as early as the age of 14 or 15 on the inferior employments of trade. The number of those who go through the whole course of study is not in general more than the eighth or ninth part of those in the fourth year.

The school fees vary from 100 to 160 francs per annum, a rather high figure compared with that fixed for the higher instruction. But there are always a great many free pupils. The consequence is that the income of these establishments is far from covering the expenses, and the deficiency is usually supplied, one half by the municipal bodies and the other half by the State.

All these practical schools have a library, a collection of philosophical instruments, a laboratory for chemistry, and, for the most part, class-rooms for drawing tolerably well supplied with models.

Advantages offered to Pupils of the Practical Schools in Prussia.

The administrative regulations of Prussia accord to pupils of the second class in the practical schools, as well as to those of the gymnasia, when they have obtained certificates of admissibility to the first class, the right of presenting themselves at the examinations for the rank of officers in the army, and, moreover, they reduce in their favour to a single year the time of military service, which is three years. Those pupils of the superior practical schools who obtain at the close of their studies what is called a certificate of *maturity*, may be admitted to the polytechnic institutes for the studies relating to civil architecture, to the school of mines, and in the army they are exempted from the examination required for the rank of ensign.

The favour which dispenses with two years of military service in the case of the pupils of the gymnasia and the practical schools who have successfully passed through the second class, appears to be open to criticism ; it creates a considerable privilege in favour of wealthy families, and, on the other hand, it strikes us as contrary to the interests of the army, which thus loses the services of a portion of the best educated youth in a country where the whole duration of active service is only three years. This exemption constitutes a kind of exoneration from military service on the ground of education. It is perhaps reasonable, however, in Prussia, where the majority of military officers are taken from the aristocracy, and where a good education does not suffice, as in France, to secure success.

After all, we see that the designation of practical schools, given in Prussia to the establishments of which we have been treating, in no way indicates the nature of the instruction therein given, which has nothing technical or practical, if the expression may be permitted. They are simply institutions of secondary instruction, from which the Greek language and the Latin poets are excluded; and in which the elements of the sciences are introduced as a

theoretical preparation for more special and afterwards technical studies. The duration of these complete studies is the same as that of the literary gymnasia and our lycées, since young men do not get through them before the age of 17 or 18.

By the special literary instruction they give, these schools are a better preparation than classical studies for commercial and manufacturing careers, for which a knowledge of the sciences, and above all of the living languages, becomes more and more necessary. But it would appear to us altogether unjust to attribute to this teaching any tendency whatever towards materialistic and revolutionary ideas. This is not the cause of the moral evil which agitates and disquiets Germany.

Practical Gymnasia (*Real Gymnasien*).

In Bavaria the literary and scientific studies of the secondary order are divided* between the establishments known as *Complete Gymnasia*, comprising classical studies, and the *Practical Gymnasia*, more especially intended to prepare young men for the public services and for industrial pursuits. The pupils enter these two kinds of establishments after remaining four years in what are called *Latin Schools*, and afterwards pass four years in one or the other gymnasium.

That which is called the practical gymnasium continues, during its course of four years, the study of religion, the German language, Latin, history, geography, natural history, the elements of mathematical science, as far as the rudiments of the differential calculus, physics, the French and English languages—all which constitute a course of instruction perfectly analogous to that of the scientific division in our lycées, and is intended as a preparation for scientific schools of a higher order. The literary studies occupy weekly 50 hours; the sciences, 24; drawing, 24; the natural sciences, 14; religion, 8.

In this organization, of which we give the most complete details in the special report on Bavaria, it is seen that 14 is the age at which youths make a decisive choice either of classical studies, properly so called, or of scientific studies, which is almost identically the plan followed in the French lycées since 1852. The practical gymnasia of Bavaria present also a strong analogy with the practical schools of Prussia and with the scientific division of our lycées.

We do not deem it expedient to enter into longer details of the true character of the practical schools of Germany, as in the special report relating to each of the States we visited will be found abundant information relative to their peculiar institutions.

Polytechnic Institutes.

The various institutions intended for commercial or industrial education present, under identical designations, very great diver-

* See the special Report on Bavaria (p. 137).

sities in Germany, but the case is different with polytechnic establishments, which, under the name of *Gewerbs-Institut* at Berlin, and of Polytechnic School or Institute in Saxony, Bavaria, Austria, Würtemberg, Switzerland, and the Grand Duchy of Baden, are intended to train civil engineers for the services of bridges, roads, mines, and manufactures, mechanical engineers, manufacturing chemists, architects, forest engineers, &c. In all these establishments scientific instruction is given in a very high degree, and sometimes even to an extent superior to the requirements and the end to be attained; but, everywhere also, the technical branch of this instruction is cultivated with the utmost care. The polytechnic institutes are at once schools of theory and of application, and present, in this respect, a very great analogy with the Central School of France.

In all these establishments the pupils enter at 17 or 18 years of age, and must possess a preparatory education corresponding to the special studies they intend to follow. The choice of his branches of study having been made by the pupil, the courses he must attend are indicated to him and become almost everywhere compulsory. However, this obligation is not always absolute, and the liberty accorded to the pupils, of not attending certain scientific courses, has the effect of inducing the professors to confine their theoretical instruction within the limits of what is really useful to those divisions.

The part of the first courses which forms the scientific foundation of the technical applications is usually common to several of the special divisions into which the pupils are separated, and each division likewise receives the peculiar instruction required for it. These divisions, more or less numerous according to the country, are in general the following :—

Engineers for bridges and roads.
Civil engineers for railways, &c.
Architects and builders.
Mechanics.
Manufacturing chemists.
Mining engineers.
Forest engineers.

All the institutes do not comprise the same number of divisions, but the first four or five are almost universally adopted, if there be no special establishment to replace them.

The peculiar arrangement and gradation of the studies nearly always possess a remarkable feature, which is that the first part of the studies of each special division, which requires one or two years, is so regulated that it constitutes a body of knowledge sufficiently complete to allow a young man to break off there and enter advantageously on the second-rate positions in the career he has chosen. After accomplishing this first part of the studies, a pupil may become an able assistant engineer of roads and bridges, or of civil architecture (*werkmeister*), a builder (*baumeister*), overlooker or head mechanician, a dispensing chemist, or foreman of chemical works, a head miner, a mining

overseer, a forest agent, &c. In more than one state, pupils are even required, after reaching this first stage of technical instruction, to pass a year or two in building yards, workshops, or factories, before going through the rest of their studies. This practice, which presents the inconvenience of interrupting the studies and exposing many pupils to the danger of forgetting a part of them, has, on the other hand, the advantage of maturing their minds by practice, of showing them the applications of science, and of not leading to higher studies any but those who really have a vocation for them. It is, however, practicable only under the system of out-door pupils, which is universal in Germany, and for pursuits in which there is no limit of age.

Day Schools.

It is well known that in Germany the general practice of educational establishments is to admit out-door pupils only. Young men, strangers to the towns where these establishments are situated, generally find board and lodging with the professors or with respectable inhabitants at moderate rates, in accordance with their means. This system has its advantages and disadvantages. It preserves for the pupils of the town the influence and action of home, and accustoms them early to follow the path of duty; for strangers however it has not the same advantage, and presents the danger of dissipation; but a judicious choice of representatives by the parents may supply a remedy, and communications are now so easy by railway, that a young man is rarely altogether isolated from his family.

Besides it must not be supposed that the discipline to which these out-door pupils are subjected is not pretty strict. It is exercised, so far as regards punctuality and industry, by the professors, and as regards conduct out of school, by the directors, who have means of repression at their command. Private admonition, reprimand before the council of professors, confinement, the threat of rustication, and lastly expulsion, are the graduated penalties really applied. No doubt a certain number of students turn out badly, but those who persevere in good conduct have acquired by the very fact, a moral strength in their young days, which enables them to enter public life early without incurring the dangers of a sudden transition from the secluded life of the lycées and colleges, to the freedom of the public schools. They have become men.

Observations on the Extent to which the Theoretical Studies are carried.

We have stated above that the mathematical studies in these institutes are of a high order. It is, however, right to remark that those which correspond to the first period we have just indicated, are nearly everywhere more elementary, and consequently accessible, to pupils who only aspire to second-rate positions in each special or technical branch. But the case is very different for the last years of study, and though we entertain the utmost respect

for the learning and zeal of the professors, we feel bound to state that generally, in these establishments, a greater range than necessary is given to the use of pure mathematics. The programmes too often contain lessons devoted to the doctrine of probabilities and to the calculus of variations, which the pupils will certainly never have to use, and which absorb valuable time. The use of the differential and the integral calculus is also carried too far. In fact, though it may be good and useful that an engineer should be familiar with the theory of the methods of the calculus, it is not equally necessary to pursue the study to such an extent in order to teach the applied sciences, which can be explained quite as accurately by elementary methods more easy to understand. It is more than probable that this extreme attention to refined mathematical theory prevents a good many pupils from completing, as they might have desired, the full course of technical studies. It would doubtless be more judicious to reserve for a special division, which is not compulsory, and is devoted exclusively to scientific studies, all these higher subjects, which would then be addressed to young men preparing to become teachers. At the Zürich Polytechnic School,* there is a division of this kind, to which are admitted, either as students or free auditors, all who desire to follow the scientific courses properly so called, and in this division lectures are also given on almost every branch of human knowledge.

Notwithstanding these reflections, which are especially dictated by the interest and esteem inspired by these establishments, it is only fair to acknowledge that this high order of instruction, carried on at the great number of polytechnic institutes founded in Germany within the last thirty years, has powerfully contributed to the development of a taste for profound scientific studies, and for the applications of science to all branches of the public service and to industry. We had been made aware of this progress some years before, by the remarkable publications which appeared beyond the Rhine on all these questions, and what we have seen has only confirmed the inferences we had drawn from an examination of the works mentioned. In this respect, Germany appears to us to have made, as regards the diffusion of the sciences, and particularly their application to the requirements of public works, arts, and industry, far more rapid progress than England; and it is important that France should seriously consider this matter, for the day is, perhaps, not far distant when Germany, joining to the low price of labour and to the frugal habits of its inhabitants all the resources of science, will become for our industry a rival as formidable as the one which, on the other shore of the channel, has hitherto most occupied our attention.

Study of applied Science.

In all the polytechnic institutes that we visited, the applications of the sciences are taught to the pupils not only by lessons, but by

* See special Report on Switzerland (p. 157).

detailed and progressive studies which they are obliged to make of all the parts of the art or of the services for which they are destined. The engineers, architects, and mechanicians study and reproduce by drawings and plans all the details of construction, from the most elementary to the most difficult and most complicated. All the parts of the plans must be calculated according to the rules of science and art.

The pupils, it is true, make very free use of works such as the hand-books published by eminent professors, as M. Weisbach and M. Redtenbach, but they must nevertheless have understood the principles on which the rules given by those learned authors are based.

Chemical Laboratories and Collections.

The chemical classes have at their disposal extensive and well organized laboratories, in which the pupils are allowed, on payment of a very moderate fee, to perform manipulations, and thus join practice to theory. Numerous collections of instruments, models, minerals, and technology, and also libraries supplied with all the new publications, complete the means of instruction.

General Arrangements.

Everywhere the halls are large, well-lighted, and space is not spared. Most of these institutes are of recent foundation, and the buildings have quite a monumental character. The rivalry of the different States has had something to do with this progress; it has led each of them to found at least one of this kind of establishments, and to make considerable sacrifices to ensure its success. Such a friendly rivalry we would fain see arise between our great manufacturing centres, as it would in a short time, without being very burdensome to the State, endow the country with the instruction so much needed to enable our industry to hold its own in the increasingly arduous struggle with foreigners.

Distribution of the Polytechnic Institutes.

These establishments, which resemble the Polytechnic School and Central School of France, are distributed through the different States of Germany as follows:

Names of States.	Number of Institutes.	Number of Inhabitants to each Institute.	
		Per State.	Mean.
Austria - - - -	5	7,400,000	5,500,000
Prussia - - - -	1	17,000,000	
Bavaria - - - -	1	4,615,648	
Würtemberg - - -	1	1,783,967	
Saxony - - - -	1	2,235,240	
Baden - - - -	1	1,359,291	

The great inequalities between the numbers of inhabitants to one polytechnic institute need occasion no surprise, since, apart from all consideration of population, each State has seen the propriety of itself providing for the intellectual wants of its population. The number of inhabitants which, for all Germany, corresponds to an institute of this kind is 5,500,000, whilst in France we have only two analogous institutions for 37,382,225 inhabitants, or one for 18,691,600 inhabitants. Evidently the whole of the German States have made, for the diffusion of the physical and mathematical sciences, as well as for their application to the public services and to industry, very considerable sacrifices, which cannot fail to produce great effects on the progress both of science and of industry.

General Influence on the Progress of Science.

Though we have felt bound to criticize the high reading of certain branches of mathematics, it is none the less true that the great number of chairs open to distinguished men of science, and the emulation engendered by the rivalry of these establishments, which dispute the honour of possessing the most illustrious professors, must direct many superior minds to scientific studies. Our most celebrated geometricians of the Academy of Sciences are aware of this; and, for some years past, they have been struck with the great scientific movement observed in Germany, as we have ourselves been by the progress made in teaching the applied sciences. We think that in respect to both these points there is a movement taking place in Germany to which France ought to pay serious attention.

We have purposely omitted introducing into the preceding comparison the German universities and the Faculties of France, because they are institutions of another order.

SPECIAL BRANCHES OF INSTRUCTION.

We have noticed, in this general Report, only institutions which, under different names, but with nearly identical objects, are found in the States we have visited. Besides these establishments, which together constitute an entire system, there are divers and in some cases special establishments of which we describe the organization in the separate reports on each country. For instance, special schools of industrial art, architecture, forest management, agriculture, navigation, and commerce, exist in several of these States, and we do not think it necessary to quote here what we have said in the special reports, where they naturally find their place.

METHOD OF TEACHING DRAWING.

We may add, as a general fact, that in all kinds of technical instruction whatever, freehand and linear drawing rightly hold a prominent place; that they serve as a means of teaching by affording ocular demonstration of many matters which could scarcely be well understood by merely mental effort. As for the methods

followed for this special teaching, that which, without exception, from the high school of Nüremberg to the humblest village classes in Würtemberg, has always and everywhere been most successful, is the one proposed by the late M. Dupuis, which has been too much neglected in France. It consists, as everybody knows, in making the pupils, either at the very outset or after a few attempts at copying model drawings (to give freedom to the hand and accustom it to act in accord with the eye), draw from subjects in relief; at first very simple, then combined and varied in position, rising gradually from subjects of ornaments in relief to drawing from the round or from nature. With a few unimportant modifications, this system is found in nearly all the schools of Germany. Persuaded as we are that one of the first and most important measures to be taken in organizing industrial education consists in teaching everywhere the art of drawing, we feel bound at once to call attention to the choice of this method.

General System of Education in Germany.

The most striking characteristic of the German institutions for national education is the general whole—the arrangement of all the establishments, which, from the primary school to the highest faculties in the university, offer the different classes of citizens a series of degrees of instruction which they may need or have the capacity to acquire. The representations of this arrangement of educational machinery, which we give in the reports on Bavaria and Austria,* render it perfectly intelligible at a glance. On leaving the primary school the child of poor parents can finish this first part of his education in the Sunday schools, the middle-class schools, or superior primary schools. He next becomes an apprentice. If his family have sufficient means he goes to the literary schools of two orders, according to his destination, and he thus attains the age of 14, either with a literary preparation which enables him to enter on his classical studies and then to attend the universities and faculties dependent thereon, or with a literary and scientific preparation which will enable him to apply himself to higher studies and afterwards technical applications.

The wants of modern society have also led all the States of Germany to that separation of studies at the age of 14, which has, somewhat derisively, been designated in France as *bifurcation*. This is in our opinion a necessity dictated, not by a desire to hurry on the studies, which none the less require eight or nine years after the primary school, but by the fact that youths are now compelled to acquire a more complete knowledge of a multiplicity of subjects than our forefathers possessed, in order to be able to meet all the conditions of the public services, and all the requirements of manufactures or commerce.

To these different opportunities offered to young men who are

* See pp. 131 and 148.

willing and able to make complete studies in one or the other direction, are added, in the interest of the less wealthy class of citizens, the schools for apprentices, the evening and Sunday schools for workmen, the higher schools for girls, the apprentice workshops varying according to local circumstances, the schools and special classes for certain trades, the agricultural schools, those for pilots, &c., so that the paths of instruction are open to all and every one according to his position, his intended career, or his capacity. In all these special branches of education, which have been organized to meet the requirements of industry, the governments, provinces, and municipalities evince the utmost liberality in aiding, by exemptions from school fees, or by grants and scholarships, industrious and intelligent individuals to prosecute their studies as far as possible, but without turning them aside from the particular career which the social position of their family requires them to follow.

It is such a system of institutions that, by the co-operation of patriotic citizens, of manufacturing firms, of mercantile towns, of the Departments and the State, we should be glad to see established in France; each of them being adapted to the local wants and the peculiar conditions of industry and of the population. If the work which we have undertaken on our return from far too short a stay in each of these states which we passed through so rapidly, can promote the solution of this important question, which has engaged our attention for many years past, we shall be amply compensated for the long researches it has entailed.

Comparison of the Expenditure for Public Instruction in different Countries.

Some benefit can hardly fail to accrue from a comparison of the sums that the different States on which we have been able to procure information appropriate for normal expenses to the departments of War and of Public Instruction. In making this comparison, we must not lose sight of the fact that in all the German States, as in France, the expenses relating to primary instruction are paid by the towns, provinces, or Departments, and that the State intervenes only when these have not sufficient resources. It is therefore just in making this comparison to take into account for all the States only the sums stated in the official budget.* On the other hand, the extraordinary appopriations for founding educational establishments being liable to vary with circumstances, they also must be left out of the account.

By following this course, and taking the budgets of the entire expenditure, the war budget and that of public instruction, we obtain the following table:

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* In France, for instance, whilst according to the official statement, No. 23, of the Ministry of Public Instruction, the total expenditure made by the country amounts to 71,453,579 fr., the sum entered in the Budget is only 6,509,100 fr., the rest is supplied by the towns and departments.

Name of Country.	Population.	Total Expenditure.	Average Contributions of each Individual.	Army and Navy.		Public Instruction.	
				Total.	Its proportional part.	Total.	Its proportional part.
	Inhabitants.	Fr.	Fr. c.	Fr.			
France - -	37,382,225	1,776,134,001	47 50	523,826,372	0·295	19,165,121	0·011
Austria - -	39,000,000	1,099,758,342	28 20	296,707,865	0·270	21,250,000	0·019
Prussia - -	17,000,000	513,613,106	30 20	141,921,506	0·276	7,071,195	0·014
Bavaria - -	4,615,648	100,213,254	21 70	21,961,880	0·219	2,165,278	0·022
Würtemberg -	1,783,967	34,103,344	19 10	7,436,094	0·218	1,613,020	0·047
Hanover -	1,910,000	78,654,750	41 12	10,182,000	0·122	996,233	0·013
Baden - -	1,359,291	34,295,705	25 20	6,336,674	0·182	1,187,060	0·033
Saxony - . -	2,225,240	39,375,000	17 70	8,437,500	0·214	1,470,000	0·037

It is seen from the comparative results contained in this table that the secondary German States, whose independence is based on the law of nations and the faith of treaties, and whose extent or political interests do not oblige them to maintain a considerable military force, can and do make sacrifices for public education proportionally far greater than the most powerful States, while the average taxation per head is much lighter. Education, the source of public and private wealth, is there developed while the military expenditure is diminished; which explains why, notwithstanding the extension everywhere given to public works and the expenditure thereby occasioned, the finances of these secondary States are in a condition so flourishing that several of them have been able to alleviate the public burdens instead of increasing them, and this even after improving the condition of the public functionaries.

June 1864.

SPECIAL REPORT ON THE EDUCATIONAL ESTABLISHMENTS OF THE KINGDOM OF HANOVER.

Primary Instruction.

A Royal ordinance, dated 26th of May 1848, repeats and confirms in the following terms the rules established for primary instruction.

"Ernest Augustus, by the grace of God, King of Hanover, "&c.

"§ 1. The teaching in the primary schools remains, according "to the constitutional law of the country, under the supervision "of the ecclesiastical authorities dependent on the ministry of "Public Instruction and Worship.

"§ 2. Our Minister of Worship shall determine the matters to "be taught, the duration of the instruction; he shall take the "measures necessary to secure regular attendance at the schools.

"§ 3. The children of every inhabitant of the country are "bound to attend the primary schools during the prescribed "period, unless they attend the classes of an educational esta-"blishment of a higher order, or receive from private teachers "the required instruction. The spiritual authority of their com-"munion may grant a dispensation.

"§ 4. The age at which attendance at school becomes compul-"sory is six years.

"§ 5. This prescribed period ends at the age laid down by "law in the different provinces of the kingdom and for the "different religious communions. Wherever there may be no "regulations laid down on this subject, our Minister of Public "Instruction and Worship is empowered to fix the time.

"§ 6. Private instruction does not dispense with attendance at

"the primary schools unless it comprises all the matters taught "in the latter, and unless the capacity of the teacher is recognised "by the authorities charged with the supervision of the primary "schools."

The number of primary schools in this kingdom is 3,600 for a population of 1,910,000 souls, or about one school for each 500 inhabitants. The number of children bound to acquire primary instruction is 315,000. The number who actually attend the schools is 296,000, or 96 out of 100 children enrolled. The remainder are taught at home or in the very numerous private schools. The law rendering education compulsory is enforced with great strictness, and very few boys are found without elementary instruction.

Improvement Schools (*Fortbildung-Schulen*) for Apprentices.

Trade corporations or guilds still exist in the kingdom, but their privileges are pretty narrowly restricted. An apprentice cannot become a free member of his trade without receiving the approbation of a committee of members of the guild, presided over by a delegate or member of the muncipal council. Among the conditions imposed on apprentices is that of having regularly attended the evening classes, and in winter especially the Sunday classes, in the schools established for the purpose, at the expense of the towns. In these schools, the apprentices improve themselves in reading, writing, German, arithmetic, and especially in the drawing of ornament, to which is added a little linear drawing and geometry. The number of these schools in the whole kingdom was 37 in 1863, and they were attended by nearly 5,000 pupils or apprentices.

The subjoined table gives the particulars :—

Number.	Schools of	Number of Professors.	Number of Pupils.	Workmen and Apprentices.
1	Alfeld - - -	3	59	48
2	Bremervörde - -	2	48	48
3	Celle - - -	3	155	155
4	Clausthal - - -	7	219	198
5	Diepholz - - -	2	46	38
6	Duderstadt - - -	4	64	64
7	Eimbeck - - -	6	112	105
8	Emden - - -	7	156	129
9	Esens - - -	6	50	47
10	Geestemünde - -	3	51	47
11	Gifhorn - - -	2	69	69
12	Göttingen - - -	10	328	316
13	Hameln - - -	6	214	198
14	Harburg - - -	5	67	67
15	Herzberg - - -	7	68	67
16	Hildesheim - - -	4	168	168
17	Lauterberg - - -	3	91	90
18	Leer - - -	7	179	170
19	Lemförde - - -	2	27	22

Number.	Schools of	Number. of Professors.	Number of Pupils.	Workmen and Apprentices.
20	Lingen - - -	3	68	65
21	Lüneburg - - -	10	232	227
22	Meppen - - -	3	57	50
23	Moringen - - -	3	40	40
24	Münden - - -	4	89	83
25	Nienburg - - -	6	101	97
26	Norden - - -	4	99	98
27	Northeim - - -	5	68	67
28	Osterode - - -	5	85	83
29	Osnabrück - - -	11	429	331
30	Peine - - -	4	157	157
31	Soltau - - -	1	39	38
32	Stade - - -	3	82	74
33	Uelzen - - -	5	90	90
34	Usiar - - -	2	108	78
35	Verden - - -	5	26	22
36	Weener - - -	4	61	53
37	Wittingen - - -	3	75	64
	Totals - -	170	4,077	3,763

Trade School of the City of Hanover.

Besides the provincial schools there is a very important one in the capital, which in the school year 1863–64, had no less than 881 pupils, of whom 608 frequented the school properly so called, 234 the preparatory school, and 39 both schools. The drawing classes of the preparatory school were attended by *337 pupils*, and those of the school proper by 334.

In the school proper the pupils were classed as follows:—

Freehand drawing, 3rd division - -	102
Special drawing, 4th division - -	149
Linear drawing, architecture, modelling, 2nd division - - - - -	67
From the cast - - - -	26
Total -	344

Apprentice-School.

There is only one apprentice-school in the kingdom. It teaches weaving, but is not of any great importance.

Workmen's Societies.

In 1862–63 there were, in the kingdom of Hanover, nineteen workmen's societies, nearly all composed of operatives. The majority of the masters and foremen did not belong to them. These societies have an organization similar to those of the city of Hanover, which we shall describe presently. The total

number of their members was about 2,376, with 210 honorary members. Their libraries contained above 6,000 different works.

The city of Hanover has three societies of this kind; the first for apprentices, the second for workmen, the third for masters and foremen. This last, which counts among its members several professors, who give lectures, meets in the assembly room, common to the gymnasium and the practical school; the only subjects treated in these sittings, which take place on Mondays, are industrial questions.

The society of apprentices was instituted under special patronage, and is carefully superintended; it consists of 300 members.

The society of workmen is composed almost exclusively of workmen. The masters and foremen who have a great number of hands under them, rarely attend these meetings. This society has 900 members in Hanover alone, and meets in premises hired for the purpose every evening from seven to half-past ten o'clock, on Mondays from four to half-past ten, and in the daytime on Sundays and holidays until eleven at night.

A candidate for admission must be 17 years of age, and have completed his apprenticeship; he must belong to a respectable trade and be of good character. On applying for admission, the candidate must pay 7½ silber groschen. His name is then written on a board kept for the purpose, and exhibited for a fortnight in the hall where the meetings are held; he is then admitted if there be no opposition. Besides the benefited members, there are honorary members, whom the society chooses from among the manufacturers or men of science who have rendered services to industry. The monthly payment of members is 5 silber groschen. It must be paid punctually, except in case of illness, under pain of exclusion and posting of the defaulter's name.

The society is governed by a committee composed of 10 members, all elected in general meeting and obliged to accept the office. It has also a literary committee, a committee of feasts, and a victualling committee, who buy wholesale and sell retail to the members for ready money whatever provisions they may want. There is also a committee of accounts, and of arbitration and law, for defending the rights of the members. The subjects of the lectures and debates are determined by a committee of education, in which are a certain number of professors. The arbitration committee receives the complaints of members, and endeavours to conciliate the parties. It is composed of twelve members, judges, and six substitutes. It pronounces its decisions and inflicts penalties, to which the members must submit under pain of exclusion; but appeals are allowed to a general meeting.

The society has a library of 2,000 volumes, and a reading-room lighted in the evening. It lends books to members on receiving a guarantee deposit of 20 silber-groschen and the address of the borrower. Besides the lecture hall, there is a room for smoking, refreshments, and reading the journals, and several others for classes given by paid professors to the members who choose to attend.

The subjects of instruction in these classes, the length of the lessons, and the number of pupils, in 1863, were :—

Subjects taught.	Number of Hours per Week.	Number of Pupils.	Subjects taught.	Number of Hours per Week.	Number of Pupils.
Drawing of ornament	4	80	Brought forward -	—	549
Industrial drawing -	4	94	French - -	4	60
Linear drawing -	4	70	English - -	4	60
German language -	4	75	Cutting out coats -	4	30
Singing - -	4	60	Modelling and wood carving.	4	15
Arithmetic - -	4	70			
Writing - -	4	70	Gymnastics - -	5	100
Mathematics - -	4	30			
			Total -	—	814
Carried forward -	—	549			

The Hanover society has a revenue of 1,300 thalers, which is carefully administered by a special committee. There are 900 members in all. The present number of these workmen's societies is about 25 in the kingdom of Hanover only ; the members are estimated at 6,000.

The worst fault and danger of these associations is in the *esprit de corps* which unites them, and which in times of disturbance might enable reckless leaders to have at their command a great number of men easily misled and excited. It must however be admitted, from the preceding table of the classes and the number of attendants, that such institutions may be useful, but they should have a different organization, of which we find a good model in the evening and Sunday classes established for workmen in Austria.

Practical School of Hanover.

In the kingdom of Hanover the gymnasia for the classical teaching which leads to the studies of the University, and the practical schools (*Real-Schulen*), where the classics are also taught, but on a restricted scale, as we have already stated, are usually established in the same building, but still altogether separate and with distinct professors. There are thus in the kingdom seventeen gymnasia and seventeen practical schools, more or less complete as to the classes. We will speak here only of the practical school of the city of Hanover, one of the best organized that we visited.

This institution was founded in the year 1835, for the education of young men whom their parents intended to follow trade or industry. At first it was intended to combine elementary, literary, and scientific studies with lessons more especially relating to commerce; but subsequently, following the example of the Prussian Government, the Hanoverian authorities excluded from the course of instruction in this school all matters either technical or special ; so that it is now an establishment for limited classical

teaching. The studies, which may comprise even primary instruction, are separated into two divisions, of which one, called the preparatory school (*vorschule*), is in reality only a primary school, comprising a three years' course; and the second, which constitutes a practical school properly so called, has seven classes of one year each. Children, therefore, admitted into the preparatory school at six or seven years of age do not leave the practical school until the age of 16 or 17, that is, after studying ten years.

The fact of its being a day-school, and of the boy going home every day, renders this long period of study less wearisome, although it seems very long for the end to be attained.

The course of instruction is chiefly literary and has nothing technical about it; the subjects are:—Religion, German, French, English, Latin, mathematics, arithmetic, history, geography, physics, chemistry and mineralogy, natural history, writing, free-hand drawing, linear drawing, singing.

The study of German, French, and Latin occupies most time; much less is devoted to English, but the analogy of that language with French as to the grammar, and with German as to words, renders its study easy to those who already know the two other languages.

In this school, as in those of Prussia, the number of pupils who go through the whole course of study is but a fraction of those who commence. About one-half of the pupils leave school at the third class, and less than one-third go through the entire course.

The school fees range from 18 to 24 thalers per year. The building which contains the practical school is also the seat of the gymnasium; but the two establishments are perfectly distinct. The only things they have in common are a handsome front towards a public square and a great hall, called the Hall of Entertainments (*Fest-Halle*). This building, which is very handsome and well-fitted for its purpose, cost the city of Hanover 230,000 thalers. The rooms are spacious, well-aired, and warmed by huge earthenware stoves, which might probably be made, with some few modifications, to serve as ventilators.

The total expenses amounted in 1862 to 11,345 thalers; the school fees produced 8,100 thalers; the city pays the difference, 3,245 thalers, and in addition to the building, supplies the furniture.

Commercial School (*Handels-Schule*).

In the building used for the practical school, the municipality of the city has established a commercial school intended to complete the education of the boys who leave the primary school and mean to follow commercial pursuits. This foundation has replaced the courses of commercial instruction, book-keeping, &c., which were suppressed in the curriculum of the practical school. The Merchants' Guild, with the consent of the municipal authority, selects the young commercial apprentices who are to

follow the courses of this school; attendance then becomes compulsory on the pupils, and the masters are bound to allow the necessary liberty.

This establishment consists of a preparatory school, for teaching writing and arithmetic to boys not sufficiently advanced, and of the commercial school properly so called, the studies of which extend over two years, divided into four terms of six months each. The subjects taught are:—Commercial correspondence, commercial geography, written and mental arithmetic, caligraphy, French and English; in the first and second class book-keeping is added; and in the third and fourth the art of commerce. In case of non-attendance the masters are apprised, and are bound to sign the paper conveying the notice. If a pupil has been kept away by the master, information of the fact is given to the magistrate. The classes are held from six to eight in the summer, and from seven to nine in winter.

This school has a small library where the pupils can borrow books, when guaranteed by their employers. All the lessons are equally compulsory, and the school fee is 4 thalers per half-year in the preparatory school, and 7 thalers for the commercial school properly so called. The pupils who have completed the two years' course are allowed to pass an examination before a committee of tradesmen, who deliver a certificate of capacity to the deserving. Those who have attended a part of the lower classes receive only a certificate relating to those classes.

Building-trade School (*Baugewerbe-Schule*) at Nienburg.

This town has a school especially intended for workmen in the building trades, and also for masters of the same profession.

The school is open only in the winter season, from the 21st October to the end of the last week in March. It is divided into three classes.

3rd Class (lowest).

	Number of Hours per Week.
German language.—Orthography, short compositions	8
Arithmetic and algebra, as far as proportion, extraction of roots, and equations of the first degree	9
Plane geometry.—Equality and similitude of triangles, calculation of areas	7
Linear drawing and descriptive geometry.—Jointing, roofs, framing	15
Physics.—General elements	4
Architectural drawing	5
Free-hand drawing and ornament	12
Total	60

2nd Class.

German language.—Syntax, punctuation, business letters	4
Algebra.—Involution, evolution, equations	6

	Number of Hours per Week.
Plane and solid geometry.—Similitude, polygons, the circle, planes, cubature	4
Descriptive geometry.—Framing of roofs, vaults, staircases, compound apparatus, parts of machines, shadows, perspective	8
Technical physics.—Forces, effects, centre of gravity, simple machines	4
Lessons on buildings for stone-cutters, masons, carpenters, slaters, with drawing of plans, sections, elevations, orders, entablatures, details	21
Lessons on building materials	3
Drawing of ornaments, from models	6
Modelling in clay or plaster, wood or stone	4
Total	60

1st Class.

German language.—Written and oral compositions	2
Manufacturers' book-keeping	2
Algebra, geometry, plane and solid (repetitions and exercises)	4
Practical geometry. — Surveying of land, roads, parts of towns, levelling, plotting	4
Technical physics.—Machines employed in building, resistance of materials, pressure of water, hoisting machines. Mechanics connected with building	6
Course on building.—Erection of houses, &c. Study of ground. Foundations. Establishment of complete projects with estimates. Design of building. Laws affecting buildings	30
Drawing of ornament	6
Modelling in plaster and clay, stone and wood	6 to 12
Total	60 to 66

This school, in 1863–64, had 14 professors and 195 pupils, of whom there were 89 masons, 87 joiners, 2 tilers, 9 millwrights and fitters, 7 cabinet-makers, 1 locksmith.

The majority of the pupils were from 17 to 25 years of age; the youngest was 15, and the eldest 37.

Polytechnic School.

This establishment, founded on the 2d of March 1831, under the name of Superior Industrial School, under the direction of Dr. Karmarsch, who is still at its head, changed its designation to Polytechnic School in 1848. Its organization presents considerable analogy with that of the universities, in so far as, though it prepares the pupils for special and technical destinations, it leaves, as to the choice of the courses to be followed, much greater latitude

than several other schools of the same kind. Free auditors having no particular destination, and pupils for the drawing lessons only, are also admitted, besides those in training for particular branches of industry.

The chief subdivisions of the teaching are regulated with a view to giving the instruction necessary: 1. For manufacturing chemists; 2. For agriculturists; 3. For surveyors; 4. For mechanicians and constructors of machines; 5. For architects; 6. For hydraulic, railway, and road engineers.

The programmes of the studies indicate for each of these specialties what courses the pupils are expected to follow, and, when once the choice is made, those courses become compulsory. In order that the special courses may be attended with profit, the pupils must show that they possess a certain amount of knowledge, or else prepare for them by attending the classes of what is called the preparatory school.

To be admitted as a pupil in the preparatory school candidates must be 16 years of age, and 17 for the upper school or for special divisions. The instruction required for the preparatory school comprises the German language and the habit of composition therein, the use of decimal fractions, the rules of three and of proportions, the elements of algebra, plane geometry, and general notions of geography and history. As for the special courses of the superior school, candidates must be masters of the matters taught in the preparatory school, of which we give the details below. However, the pupils who intend to follow only the courses of natural history, are not obliged to undergo an examination in mathematics. No examination whatever is imposed on those who mean to attend only the lessons on drawing and modelling.

Programme of the Preparatory School.—Elementary mathematics, algebra as far as equations of the third and fourth degrees. Elements of geology and botany. Elements of mineralogy. Free-hand drawing. Linear drawing. Elements of descriptive geometry.

Programme of the Upper School.—Pure mathematics, in two courses, as far as the calculus of variations. Descriptive geometry. Practical geometry. Mechanics. Higher mechanics, theoretical and applied. Construction of machines. Study of machines. Study of prime movers and other machines. Building construction, in three courses. Roads and railways. Bridges and hydraulic constructions. Geology, mineralogy, and physical geography. Pure physics. Applied physics. Chemistry, theoretical and applied with manipulation. Manual labour, including instruction in working in metals and in wood, spinning and weaving, modelling, and the construction of small models.

Plans of Studies.—To enable the pupils to select the courses which they may attend, and to prevent numerous inquiries, the general regulations state that the preparatory school comprises, in the course of a year, the following subjects: zoology, botany, mineralogy, elementary mathematics, free-hand and linear drawing.

The order of the studies, after leaving the preparatory school and for special branches, is shown by the following programme :—

For Chemists :—

1*st year.*—Preparatory school.

2*nd year.*—Theoretical chemistry, technology, theoretical and applied physics and mechanics.

3*rd year.*—Geology and physical geography, or instead, general knowledge of machines and applied chemistry.

4*th year.*—Chemical manipulation.

For Agriculturists :—

1*st year.*—Preparatory school.

2*nd year.* — Theoretical chemistry, technology, physics, mechanics.

3*rd year.*—General knowledge of machines, first course of building construction, practical geometry and drawing of plans, or else chemical manipulation, practical chemistry.

For Surveyors :—

1*st year.*—Preparatory school.

2*nd year.*—First course of higher mathematics; theoretical and applied physics ; descriptive geometry.

3*rd year.*—Practical geometry with drawing of plans. Geology and physical geography.

For Mechanicians and Machine Makers :—

1*st year.*—Preparatory school.

2*nd year.*—First course of higher mathematics ; mechanics, technology, descriptive geometry, theoretical physics.

3*rd year.*—Knowledge of machines, construction of machines, first course of construction, higher mechanics.

4*th year.*—Knowledge of special machines ; second course of higher mathematics, pure chemistry, applied physics.

For Architects :—

1*st year.*—Preparatory school.

2*nd year.*—First course of higher mathematics ; technology, descriptive geometry, mechanics, theoretical physics.

3*rd year.*—First course of construction, and ornamentation, practical geometry and drawing of plans, general knowledge of machines, modelling, drawing from the cast.

4*th year.*—Second course of construction, and ornamentation, physical geography, construction of roads and railways, modelling and drawing from the cast.

5*th year.*—Third course of construction, and ornamentation, bridges and hydraulic constructions, theoretical chemistry.

For Civil Engineers :—

1*st year.*—Preparatory school.

2*nd year.*—First course of higher mathematics; technology, descriptive geometry, theoretical physics, and mechanics.

3*rd year.* — Second course of higher mathematics; first course of building construction; practical geometry and drawing of plans, construction of machines.

4*th year.*—Road and railways; second course of building construction ; higher mechanics, physical geography, and applied physics.

5th year.—Hydraulics and construction of bridges, third course of building construction; special machines, and theoretical chemistry.

Pupils and Auditors.—According to the statistical returns the pupils of the Hanover Polytechnic School come from the different institutions in the following proportions:—

Out of 100 pupils admitted, there came from:

The classical gymnasia - - - -	18·3
The upper middle-class schools, practical and technical schools, the practical gymnasium, the schools of commerce and of mines - -	18·9
From private tuition - - - -	21·9
From workshops and factories - - -	25·6
From other polytechnic institutes - -	4·8
From the builders' schools - - -	3·3
From the lower schools - - - -	0·6
Officers and government clerks - - -	4·5
Professors - - - - -	2·1
Total - -	100

The pupils of the upper school may attend any courses they choose, provided the standing regulations and the regular order of studies be not infringed. All the pupils are bound to attend the courses punctually, to be present at the exercises, drawing, manipulations, and to observe, in general, the rules of the school, which are made known to them when admitted. At the end of every year, in the month of July, the pupils who make the application, and whose number is mostly two-thirds or three-fourths of the whole, are admitted to examinations bearing on the whole course of instruction and on their work. If merited, a certificate is delivered to them, declaring their regular attendance and proficiency. These certificates are of three degrees; in certain cases, the words "with distinction" are added, and books are given as prizes.

Persons occupying an independent position, or who attend the universities, may be admitted as free auditors. These last are not entitled to claim certificates of progress and application. Those who do not fulfil the conditions above mentioned may be admitted as free auditors on a written application from their parents or guardians, and in this document the applicant must state that he is aware that the person for whom he acts has no right to expect a certificate. Any person who has entered his name as a free auditor has the privilege, during the first three months, up to New Year's Day, of being admitted as a pupil by merely making known his wish to the Director.

Observations.—The details which have been given show that the order of the teaching is so regulated that, for certain important divisions, such as those of mechanicians and architects, pupils may receive a very serviceable amount of technical instruction, with the aid of elementary mathematics, and enter upon the practice of their professions without going through the whole

course of studies. Such an arrangement is very suitable for many young men, and in no way injurious to the soundness of their education.

Thus, to enable them to attend the first course of mechanics, the course of construction of machines, those of hydraulics, prime movers, and of the principal machine-tools, and for the drawing up of projects relative to these machines, the mechanical engineers do not require more than the elementary and fundamental principles of geometry, algebra, trigonometry, and descriptive geometry. There is no necessity for them to study the higher pure mathematics, which, notwithstanding their utility, present considerable difficulties to certain minds, and require no little time and effort. The same may be said of the instruction given to architects; for after attending the first two courses of construction, the pupils may have acquired the knowledge necessary for ordinary buildings (*constructions civiles ordinaires*).

This gradation of instruction greatly diminishes the inconvenience, above-mentioned, of the high reading in the second course of pure mathematics. Moreover, the table showing the distribution of the students among the different branches of learning which we are about to give, justifies our observations; for it will thereby be seen that whilst 89 pupils are inscribed for elementary mathematics, and 83 for the first course of higher mathematics, there are only 14 for the second course of the same studies. It is therefore more than probable that a small proportion of the 83 pupils of the first course really profit by those lessons. The truth of this observation seems to have been recognized, for the second course of higher mathematics has ceased to be obligatory since 1863–64.

Distribution of the Pupils among the different Branches of Instruction.—This table relates to the year 1863–64.

Subjects taught.	Number of Pupils.	Subjects taught.	Number of Pupils.
Elementary mathematics -	89	Zoology and botany -	52
Pure mathematics 1st course	83	Mineralogy - -	57
Pure mathematics 2nd course	14	Geology - - -	40
Mechanics - -	93	Theoretical physics -	24
Higher mechanics -	60	Technical physics - -	10
Practical geometry -	57	Theoretical chemistry -	50
Descriptive geometry -	73	Technical chemistry -	27
Study of machines - 1st course -	86	Practical chemistry -	29
Study of machines - 2nd course	37	Technology - -	82
Construction of machines -	65	Linear drawing - -	79
Construction of buildings - 1st course -	79	Free-hand drawing	96
Construction of buildings - 2nd course	45	From the round and reliefs	10
Construction of buildings - 3rd course -	27	Modelling - -	5
History of the art of building.	15	French language - -	11
		English language - -	21
Construction of roads and bridges.	39	History - - -	16
		Law and police of buildings	20
Hydraulic constructions -	30		

This table clearly shows what courses best suit the requirements of the class of persons who attend institutions of this kind.

They are in the order of the preceding table:—Elementary mathematics; first course of pure mathematics (which might be simplified); elementary mechanics (which might be extended); practical geometry; descriptive geometry; the study of machines, first course (which might be made more elementary); the construction of machines; building construction; zoology and botany; theoretical chemistry; technology; linear drawing; free-hand drawing.

It would therefore seem that attention ought to be directed principally to these different branches of learning, and every effort made to facilitate their study by the adoption of the simplest methods. It seems clear that the teaching of the sciences of a high order has a repellent effect on the pupils. That physics should be among the number of the studies least followed is remarkable and much to be regretted. There are, perhaps, particular causes for this, but, in any case, that science ought to hold a higher rank in the programme and to have greater facilities for experimenting.

Number of pupils.—In the year 1862–63 the total number of pupils was 440, of whom 379 were regular pupils and 61 free auditors; there were also 85 in the preparatory school. The great majority of the pupils in the higher school were from 11 to 20 years of age, one-twelfth only were 16, and about one-eighth 17 years of age.

Number of professors.—The establishment has 21 regular professors, three tutors, and several special teachers.

Budget.—The yearly expenses amount to about 23,750 francs, of which 31,500 francs are covered by the school fees. The State pays the balance and likewise supplies the building and all the furniture. The original outlay for the teaching apparatus was about 100,000 francs, and a sum of from 8,000 to 9,000 francs is appropriated yearly for additions.

Collections.—A very good library, containing 15,000 volumes of literary and scientific works, is placed at the disposal of the professors and pupils, who are allowed to take home the books they may want. Technical albums and very numerous collections of drawings are placed in the class-rooms, to be consulted by the pupils. A gallery of models of machines, well selected and in great variety, contains numerous models on reduced scales, which can be carried into the class-rooms when required. A technological collection of raw materials and productions of the chief industries of the country, exceedingly well classified, is especially rich in illustrations of the metallurgical and metal working industries.

The chemical laboratories, one for the professor, the other to receive 20 pupils in chemistry, are well organized and supplied with collections necessary for study. There is also another laboratory specially devoted to assaying by the dry method. The cabinet of physics is not remarkable, though tolerably well sup-

plied with the principal instruments. Those for land surveying and plotting are provided with all the apparatus necessary for practical application. There is no workshop for mechanics, because it is believed that it would be little frequented by the pupils, and that its products would not be in proportion to its cost.

In this kingdom, the ministerial departments being few in number, the polytechnic school is under the management of the Ministry of Public Instruction and Worship, and the studies are supervised by a superior council dependent on that ministry. A committee presided over by a member of the municipal council has the control of the financial management. The professors meet once every month to confer on questions of instruction and discipline.

From these particulars it will be seen that the Polytechnic School of Hanover, one of the oldest in Germany, well deserves the high reputation it enjoys. It may be taken as a model for such institutions, combining as it does the characteristics of a university with those of schools more especially technical.

The general budget of the kingdom of Hanover, for a population of 1,910,000 souls, amounts to 78,654,750 francs. Of this sum the State devotes to the military service 10,182,000 francs, or 0·128 of the whole budget, and to public instruction 996,233 francs, or 0·013 of the whole budget.

This account of the different establishments for the diffusion of knowledge, from the most rudimentary teaching to that of the pure and applied sciences of the highest order, shows that the most liberal spirit has constantly inspired the Government of Hanover from the time of Leibnitz to the present day.

SPECIAL REPORT ON THE EDUCATIONAL ESTABLISHMENTS OF THE DUCHY OF BRUNSWICK.

Collegium Carolinum.

The present object of the college is to prepare young men by a scientific and technical education, for the special careers of—Mechanicians, Civil Engineers, Architects, Metallurgists, for mining and salt works, Manufacturing or dispensing chemists, Forest engineers, Agriculturists, Officers for railways and roads, and Surveyors.

These subdivisions appear to be rather too numerous, and part at least might be withdrawn or taught at separate establishments. From the comprehensive curriculum, each pupil chooses

the subjects required for his future destination. But when the pupil has entered his name for a particular line of studies, and he wishes to obtain from the College a certificate of proficiency he is obliged to follow all the courses taught in that technical branch.

Besides these special studies there are general courses of literature, living languages, history, general and political geography, statistics, political economy, which the pupils are encouraged to follow as useful adjuncts to the scientific teaching.

The duration of the complete studies of the nine technical divisions is fixed as follows :—

	Duration of the special studies.
1. Construction of machines - - -	3 years.
2. Civil engineering, construction and architecture - - - - -	4 „
3. Metal works and salt mines - -	3 „
4. Manufacturing chemistry - - -	3 „
5. Dispensing chemistry - - -	1 „
6. Forest economy - - - -	2 „
7. Agricultural economy - - -	2 „
8. Service of railways and posts - -	1 „
9. Government survey - - -	2 „

The teaching elementary mathematics, experimental physics, general chemistry, the rudiments of the natural sciences and of free-hand drawing, is common to all the divisions. Moreover, proof of sufficient preparatory instruction is required for admission to each of the special divisions.

At the end of every year's studies, the Director and professors decide as to the passing of the pupils to the upper class of their division. Those whose proficiency is doubtful have to undergo, on their return after the vacation, a special examination, after which the decision is given. A pupil who has followed the complete courses of his division receives on leaving a certificate declaring his proficiency.

Besides the pupils regularly matriculated for the technical divisions, free students are admitted to certain courses, as well as to the lessons in drawing, painting, and sculpture; young men are at all times admitted to the class rooms and studies.

Numerous and well arranged collections and a good library are placed at the disposal of the professors and may be used by the pupils.

The following tables show the number of hours allotted weekly to each branch of instruction for the special divisions. Each paragraph corresponds to a half-year.

The pupils who do not follow the plan of studies indicated for any special branch are not entitled, on leaving, to receive the certificate relating thereto.

The courses marked (*) are not compulsory ; but the pupils are earnestly recommended to follow punctually the courses comprised in their studies, and not to neglect those which tend to the general culture of the mind.

First Technical Division.—Mechanicians and Constructors of Machines.

In order to shorten the length of the studies, the pupils begin to attend the special courses before their instruction in the higher mathematics is completely terminated. The courses of construction of machines are to follow simultaneously and in connexion with those of mechanics, the study of machines, of projects, and exercises of construction.

1st Year.—1st Term.	Number of Hours per Week.
Arithmetic and algebra	5
Geometry and trigonometry	5
Knowledge of instruments	2
Experimental physics	5
Inorganic chemistry	5
Free-hand drawing	—
2nd Term.	
Stereometry and spherical trigonometry	5
Equations	2
Analytical geometry	5
*Practical geometry	5
Experimental chemistry, second course	5
*Drawing of plans	—
Free-hand drawing	—
2nd Year.—3rd Term.	
Differential calculus, 1st course	5
Descriptive geometry, 1st course	4
Mineralogy	5
Technical chemistry, 1st course	5
Drawing of machines	—
4th Term.	
Differential calculus, 2nd course	5
Descriptive geometry, 2nd course	4
Geology	5
Mechanics, 1st course	4
Elements of building construction	4
Drawing of machines	—

Second Technical Division.—Construction of Buildings.

The divisions for the construction of buildings, for civil engineering, and for architecture have nearly all the preparatory studies in common; they have also several points in common with the special studies. So, when the pupils have decided for one or other of the eight subdivisions, it is only in the exercises of drawing, projects and the applications relating thereto, that their teaching differs from that of the other two subdivisions.

	Number of Hours per Week.
1st Year.—1st Term.	
Arithmetic and algebra	5
Geometry and trigonometry	5
Knowledge of instruments	2
Experimental physics, 1st course	5
Inorganic chemistry	5
Free-hand drawing	—
2nd Term.	
Stereometry and spherical trigonometry	5
Theory of equations	2
Analytical geometry	5
Practical geometry	5
Experimental physics	5
Drawing of plans	—
Free-hand drawing	—
2nd Year.—3rd Term.	
Differential calculus, 1st course	5
Descriptive geometry, 1st course	4
*Land surveying	2
Technical chemistry	5
Mineralogy	5
History of architecture, 1st course	2
Drawing of ornaments	—
4th Term.	
Differential calculus, 2nd course	5
Descriptive geometry, 2nd course	4
*Higher land surveying	3
Geology	5
Mechanics, 1st course	4
Elements of building construction, 1st course	1
Drawing of ornament	—
Architectural drawing	—
3rd Year.—5th Term.	
Differential calculus, 3rd course	2
Descriptive geometry, 3rd course	4
Technical physics, 1st course	2
Mechanics, 2nd course	5
Elements of building construction, 2nd course	4
Architectural drawing and construction	—
6th Term.	
Technical physics, 2nd course	2
Mathematical physics, 2nd course	2
Mechanics, 3rd course	4
Elements of building construction, 3rd course	4
History of architecture, 2nd course	4
Building materials	2
Architectural drawing and construction	—

4TH YEAR.—7TH TERM.	Number of Hours per Week.
Analytical mechanics	4
Mechanics of building	2
Roads and railways	4
Building of bridges	4
Civil law	3
Drawing of buildings	—
Architectural projects	—
Landscape drawing	—
8TH TERM.	
Hydraulic constructions	4
Study of machines	4
Law relating to the erection of buildings	2
Drawing of constructions	—
Architectural projects	—
Landscape drawing	—

Third Technical Division.—Salt Mines and Metallurgical Works.

These two subdivisions require the same preparatory studies. For the salt-mines a sound knowledge of geology and fossils is required, and for metallurgical works great proficiency in chemistry and mineralogy.

1ST YEAR.—1ST TERM.	Number of Hours per Week.
Arithmetic and algebra	5
Geometry and trigonometry	5
*Knowledge of instruments	2
Experimental physics, 1st course	5
Inorganic chemistry	5
Free-hand drawing	—
2ND TERM.	
Stereometry and spherical trigonometry	5
Theory of equations	2
Analytical geometry	5
*Practical geometry	5
Experimental physics, 2nd course	5
*Drawing of plans	—
Free-hand drawing	—
2ND YEAR.—3RD TERM.	
Differential calculus, 1st course	5
Descriptive geometry, 1st course	4
Technical physics, 1st course	2
Chemical physics	2
Mineralogy	5
Drawing of machines	—
Manipulations in the laboratory	—

4TH TERM.	Number of Hours per Week.
Differential calculus, 2nd course	5
Descriptive geometry, 2nd course	4
Technical physics, 2nd course	2
Geology	5
Mechanics, 1st course	4
Elements of construction	4
Drawing of machines and constructions; manipulations	—
3RD YEAR.—5TH TERM.	
Mechanics, 2nd course	5
Mineralogical exercises	2
Elements of construction, 2nd course	4
Projects of metallurgical works	—
Manipulation in the laboratory	—
6TH TERM.	
Mechanics, 3rd course	4 or 5
Metallurgy	2 or 3
Geological exercises	2
Elements of construction, 3rd course	4
Projects of metallurgical works	—
Manipulations in the laboratory	—

Fourth Technical Division.—Technical Chemistry.

Besides a profound acquaintance with chemistry, the pupils of this division must know something about the construction of machines and buildings. An acquaintance with descriptive geometry is consequently necessary for them.

In the third year they are almost exclusively *occupied* with manipulations in the laboratory.

1ST YEAR.—1ST TERM.	Number of Hours per Week.
Arithmetic and algebra	5
Geometry and trigonometry	5
Experimental physics, 1st course	5
Inorganic chemistry	5
Free-hand drawing	—
2ND TERM.	
Stereometry and trigonometry; physics	5
Experimental physics, 2nd course	5
Organic chemistry	5
Botany	5
Free-hand drawing	—
2ND YEAR.—3RD TERM.	
Descriptive geometry, 1st course	4
Chemical physics	2
Technical chemistry, 1st course	5

	Numbe rof Hours per Week.
Technical physics, 1st course	2
Mineralogy	5
Drawing of machines and laboratory manipulations	—
4TH TERM.	
Descriptive geometry, 2nd course	4
Technical chemistry, 2nd course	5
Technical physics, 2nd course	2
Geology	5
Drawing of machines and laboratory manipulations	—
3RD YEAR.—5TH TERM.	
Elements of machinery	4
Statistics	3
Projects of manufactories and working in the laboratory	—
6TH TERM.	
Political economy	3
Projects of manufactories and working in the laboratory	—

Fifth Technical Division.— Pharmaceutical Chemists.

The pharmaceutical studies must have been preceded by a practical apprenticeship.

1ST YEAR.— 1ST TERM.	Number of Hours per Week.
Arithmetic and algebra	5
Geometry and trigonometry	5
Experimental physics, 1st course	5
Inorganic chemistry	5
Manipulation in the laboratory	—
2ND TERM.	
Experimental physics, 2nd course	5
Organic chemistry	5
Botany	5
Pharmacy	5
Chemical jurisprudence	2
Manipulation in the laboratory	—
2ND YEAR.—3RD TERM.	
Mineralogy	5
Zoology	5
Pharmacognosy	4
Chemical physics	2
Manipulation in the laboratory	—

Sixth Technical Division.—Forest Economy.

The plan of studies here separates the special from the preparatory studies. The pupils in the forest service of the country are advised to follow the first year of this division immediately on leaving the primary or other elementary school, and then to have a year's practical apprenticeship in the forests, before they come to follow the special course of the second year.

	Number of Hours per Week.
1st Year.—1st Term.	
Arithmetic and algebra	5
Geometry and trigonometry	5
Experimental physics, 1st course	5
Inorganic chemistry	5
Zoology	5
Mineralogy	5
2nd Term.	
Stereometry and spherical trigonometry	5
Practical geometry	5
Experimental physics, 2nd course	5
Organic chemistry	5
Botany	5
Geology	5
2nd Year.—3rd Term.	
Mathematical exercises	2 to 4
Climatology and knowledge of soils	2
Physiology of forest plants	4
Forest botany and culture of forests	6
Valuations of forests	3
Forest history and statistics	2
Civil Law	3
4th Term.	
Mathematical exercises	2 to 4
Organization of labour	4
Protection of forests.—Forest insects	4
Forest economy and police	4
Utilization of forests	3
Elements of the chase	2
Forest laws	2

Seventh Technical Division.—Rural Economy.

The pupils are advised to separate their studies in the same manner as in the preceding division.

1st Year.—1st Term.	Number of Hours per Week.
Arithmetic and algebra	5
Geometry and trigonometry	5
Experimental physics, 1st course	5
Inorganic chemistry	5
Zoology	5
Mineralogy	5
2nd Term.	
Stereometry and spherical trigonometry	5
Practical geometry	5
Experimental physics, 2nd course	5
Organic chemistry	—
Botany	—
Geology	—
Drawing of plans	—
2nd Year.—3rd Term.	
Agricultural economy	—
Anatomy of domestic animals	—
Rearing of cattle	—
Rearing of horses	—
Technical chemistry	—
*General knowledge of machines	—
Agricultural book-keeping	—
4th Term.	
Theory of agriculture proper	—
Culture of plants	—
Diseases of domestic animals	—
Elements of surgery and medicine	—
Valuation of farm property	—
Elements of agricultural building construction	—
Manipulations in the laboratory	—
3rd Year.—5th Term.	
Differential calculus, 3rd course	2
Descriptive geometry, 3rd course	4
*Technical physics	2
Mechanics, 2nd course	5
Construction of machines, 1st course	2
Elements of building construction, 2nd course	4
Construction of machines (exercises)	—
6th Term.	
Technical physics, 2nd course	2
Mathematical physics	2

The young men who do not matriculate for the six months' term pay three thalers for a course of three hours a week, six thalers for one of five hours; the maximum paid is 18 thalers, whatever number of courses may be followed. For the laboratory, these pupils pay 10 thalers, and to the attendant 20 gros.

For daily participation in the lessons in arts, from eight in the morning till two in the afternoon, the fee is three thalers per quarter, and half that sum for three days a week.

The matriculation fee is two thalers, with 20 gros. to the apparitor and 10 gros. for the admission card.

Discipline.—Though all the pupils live outside the college, discipline is maintained in-doors and in the classes by the professors, each for his own course, and by the managing committee for general order and conduct out of college.

The Polytechnic Institution of Brunswick has no less than twenty-five professors for the different branches of instruction there given.

Builders' School at Holzminden.

In this small town of the Duchy of Brunswick, there is an establishment for special instruction, which, by a remarkable exception to the general rule in Germany, receives boarders. It is devoted to the class of artisans designated in France under the general term of the building trade: masons, stone-cutters, carpenters, joiners, smiths, slaters, glaziers, painters, cabinet-makers, &c.

The instruction is chiefly given during the winter half-year, when work is generally suspended; but it is continued during the fine season also for those pupils who are disposed to attend. To be admitted, a young man must have already entered one of the trades connected with building, and must supply the necessary information as to his age, his parents, his residence, the master for whom he has worked, and as to his moral character; he must also submit to a medical examination with regard to his health. During their stay at the school, the pupils wear a uniform, which facilitates discipline. On entering they must bring linen, a few other articles, and a case of mathematical instruments.

The establishment supplies during the usual term of residence, which is twenty weeks for the winter half-year:—

Lodging and board for the sum of - -	27 thalers.
Teaching, firing, lighting, necessaries for writing and drawing, the uniform, medical attendance and washing, for - - - -	45 thalers.
Total -	72 thalers.

Thus, during this period of one hundred and forty days, a young man can be boarded, lodged, taught, and supplied with every necessary for less than two francs per day.

The pupils are divided according to their proficiency, into three classes. In the two lower classes, the pupils are improved in ordinary and commercial arithmetic, writing, and composition. At the same time in all the classes they are taught free-hand drawing, details of construction, of ornament, of line-drawings relative to their different trades, the objects and models being chosen according to the capacities of the pupils.

The discipline is nearly the same as in a college. They rise at six in the morning, wash themselves and perform other necessary duties till half-past eight, and the studies continue till half-past nine in the evening, except the intervals for meals and recreation. They go to bed at ten. The school can accommodate five hundred and fifty pupils.

At the close of each complete period of instruction, the pupils who are found deserving, and have attended long enough, receive a certificate stating their degree of proficiency in the studies bearing on their profession. The pupils who have not completed their studies receive a certificate of their conduct and application during the time passed at the school. This certificate must be countersigned by their parents or masters when they return for the next half-year.

The general curriculum of the school comprises calligraphy, orthography, composition, ordinary and commercial arithmetic, the elements of algebra, book-keeping, elementary geometry, descriptive geometry, projections, stereometry, elementary and technical physics, the details of the construction of machines and buildings; joining of stone, wood, and iron; technical chemistry, the knowledge of building materials, drawing up of estimates, laws affecting buildings, free-hand drawing, architectural drawing, studies of forms and orders, drawing of machines, drawing up of projects, modelling. The pupils are expected, during the summer half-year, to visit works in course of execution, and write reports of their excursions.

SPECIAL REPORT ON THE GENERAL ORGANIZATION OF INSTRUCTION IN PRUSSIA.

The following is a classified list of the educational institutions in Prussia, showing also the Government Department under which each is placed :—

Designation of the Establishments.	Ministry on which they depend.
Primary and Sunday schools (children under 15 years of age).	Public Instruction.
Middle-class schools (*Bürger Schulen*) - -	Id.

Designation of the Establishments.	Ministry on which they depend.
Schools for children employed in factories	Commerce.
Apprentice schools, weaving schools	Id.
Schools and lectures for apprentices, for workmen	Id.
Conferences and associations of workmen	Id.
Industrial schools	Id.
Special industrial schools. 1. Of architecture (*Bau Akademie*)	Id.
Special industrial schools. 2. Of mines (*Berg Akademie*)	Id.
Special industrial schools. 3. Of industrial drawing (*Muster Zeichnen Schule.*)	Id.
Special industrial schools. 4. Of pilotage and navigation	Id.
Practical schools (literary)	Public Instruction.
Gymnasia (classical)	Id.
Polytechnic Institute (*Gewerbe Institut*)	Commerce.
Universities and Faculties	Public Instruction.

From the list it will be seen that the primary schools, the practical schools, the gymnasia, and the universities with their faculties, are under the supervision of the Ministry of Public Instruction, and that the educational institutions connected with commerce and industry of every kind, including the Polytechnic Institute, depend on the Ministry of Commerce.

Primary Instruction.

The regulations for ensuring a compulsory system of education in Prussia are by no means a dead letter; the execution and the results correspond in every respect. On the one hand, the statistical returns relative to the recruitment of the army show that, out of 1,000 young men of 20 who enter the service, there are not more than 30 unable to read and write. On the other hand, the following statistical table of the population *between* five and 14 years of age, the extreme limit of the *school age and* of real attendance, published by the Prussian Government, shows to what extent the law is respected and observed in all the provinces.

Names of the Provinces.	Number of Children					
	Bound to attend the Schools.		Attending the Schools.		Per 1,000 who attend the Schools.	
	Boys.	Girls.	Boys.	Girls.	Boys.	Girls.
Prussia	281,751	278,652	200,093	193,241	712	690
Duchy of Posen	151,181	150,328	109,574	105,406	698	700
Brandenburg	233.619	227,954	178,887	174,783	750	765
Pomerania	144,032	140,070	105,388	103,087	715	737
Silesia	314,648	316,531	260,955	261,485	828	825
Saxony	196,775	222,217	167,728	167,234	798	751
Westphalia	163,340	156,909	134,470	129,464	790	772
Rhenish Provinces	313,883	306,724	264,617	254,052	809	830
Hohenzollern	5,719	5,932	5,028	7,213	900	—
Fortresses and Federal Posts.	174	234	—	—	—	—
Totals	1,805,122	1,805,551	1,426,740	1,395,965	790	773

This table comprises the whole of the children from five to 14 years of age, forming, according to the census, the number of those who between those limits of age ought to attend the primary schools. But, on the one hand, a considerable number of children five years old are too weakly to be compelled to go to school, and, on the other hand, a certain portion of the children have gone through these studies satisfactorily at 12 years of age, and are allowed to pass to the higher schools; while others again have been taught at home. Consequently the comparison of the number of children who attend the schools with that of the children of the age when attendance is compulsory is made on far too high an estimate of the latter number. The author of the statistics just given is, owing to his official position, well able to appreciate this error, and he estimates the total number of boys who ought to attend the schools at 1,460,259, and of girls at 1,437,455, which would raise the ratio of real attendance to 978 per thousand for boys, and 971 per thousand for girls. These figures must be nearer the truth than the preceding, and moreover agree more closely with the data supplied by the recruitment of the army, which show only 30 men per 1,000 unable to read and write. The two results combined therefore show, that in Prussia the law which makes attendance at the primary schools compulsory, is uniformly observed and executed in all the provinces of the kingdom, and that the object of this teaching is completely attained, since all the young men of 20 can read and write.

The Prussian Government has also appreciated fully the obstacle to the intellectual advancement of the people, presented by the employment of children of tender years in manual labour. Regulations, dated 9th March 1839, 16th May 1853, 18th August 1853, and 12th August 1854, have successively fixed and modified the general conditions of children's work in factories.

According to the Royal Ordinance of 16th May 1853, children cannot be allowed, after the 1st July 1855, to work in factories until full 12 years of age. From the 1st October 1853, young persons under 16 cannot be admitted to work in factories until their father or guardian shall have presented a pass-book containing the day, month, and year of the holder's birth, and stating his religion; the name, profession, and domicile of his father or guardian; a certificate stating that he can read and write. The manufacturer is to keep this pass-book, show it to the authorities whenever required, and return it to the parent or guardian when the young man leaves his service.

Children under 14 years of age cannot be compelled to work above six hours per day. Three hours per day must be devoted to school. It is absolutely forbidden to make children under 16 work before five in the morning, or later than half-past eight at night.

All persons who employ children under these conditions are bound to give notice thereof to the police authorities, and to make

a return every half year of the number of young people above 16 years of age in their employment. Infringements of these regulations are punished by fines. Moreover, the magistrate is empowered, in case of a third infraction in the space of five years, to suspend the working of children under 16 in the offending factory.

A separate article prescribes the supervision of the manufactory, with regard to health and morals, to the separation of children from adults, and especially of girls under 16 from men and boys; the isolation of the sexes if the workpeople sleep on the premises; and the appointment of a person to take note of the arrival and departure of the children. Wages must be payed to the parents, and an examination held whether the kind of occupation or the nature of the preparations is injurious to the health of the children. Proper ventilation is secured in the workshops where dust is produced.

The State appoints inspectors to watch over the execution of the regulations.

Upper Weaving School at Elberfeld.

In this town, where the principal industry,—that of weaving,—has doubled the population within the last 30 years, there was founded in 1845, chiefly with a view to the local manufacture, a superior school of weaving, for which the town erected an appropriate building and the Government supplied the looms and furniture.

This school comprises three distinct divisions, which may be attended by all the pupils if they please :—

1st division	-	Weaving.
2nd division	-	Pattern drawing.
3rd division	-	Chemistry, colours for printing.

The instruction given comprises the fundamental principles of the theory of weaving, the knowledge of the properties of textile substances, the elements of the composition and decomposition of plain and figured tissues, preparing the cards, the composition of new patterns, the art of graduating the colours for all sorts of fabrics. Drawing is taught by Dupuis' method, that is, by exercising the pupils from the very beginning in sketching from nature or from models in relief.

The course extends over three half years, during which the sittings occupy 36 hours per week. Each pupil keeps a book in which are collected the patterns of different kinds of tissues which he has to analyse and decompose, calculating their elements and reproducing the perforations of the cards by sketches.

The school fee is 120 thalers for the three half years; for the first course only, it is 90 thalers, and for the second 60 thalers. Besides the special courses the pupils are allowed to attend gratuitously the courses of drawing, physics, and chemistry.

The establishment possesses 42 looms; the pupils have to work at them to practise both the preliminary preparations and actual weaving. When they have made the pattern of a tissue and prepared the cards, they have to make ready the loom and begin working. The materials are supplied by the school, but, as a general rule, little work is done and the materials are not fully utilized.

This school could accommodate 160 pupils, but it is attended by barely half that number; for weaving, 45; for drawing, 25; for chemistry, 8; in all, 79. A few of the pupils come from other countries, and some even from France. The laboratories are well organized and can receive from 20 to 30 pupils at least: here the pupils practise the analysis special to their industry.

The annual expenditure for the school amounts to about 10,000 thalers, and the excess of the expense over the receipts is borne one half by the State, the other half by the town.

Two other schools of the same kind have been founded in Prussia; one of them, in 1834, at Mülheim, for the manufacture of cotton and woollen stuffs; the other, at Crefeld, for velvet; they are conducted in the same manner.

These schools do not seem to be attended by precisely the right sort of pupils, nor do they make the best possible use of the means so liberally placed at their disposal. The plan followed at Stuttgart, in a similar establishment, appears to be far preferable. There the pupils are intelligent young men already trained to work the loom and to the details of preparation and tolerably advanced in drawing and primary instruction. At the school they are improved in the study and application of principles by making them do real work, so as to fit them for becoming overseers of workshops. The success obtained in the Mulhouse school of weaving, however, where the pupils are bound to work regularly at the looms, proves that it is possible in schools of this kind to impart to young men, already educated, sufficient practical knowledge to enable them to undertake the management of manufactories.

Improvement Schools (*Fortbildung-Schulen*) for Young Workmen.

Under this designation there are schools intended to give young workmen already engaged in their trades the supplementary instruction necessary for them. The teaching is directed to improving them in writing, in the German language with a little literature, in the French and English languages, in drawing applied to different professions, arithmetic, geometry, the elements of physics and chemistry, in mechanics, geography, book-keeping, and in the general knowledge of commerce, technology, manufactures, and history. These schools profess to complete the education given in the elementary and middle-class schools. The courses are divided into half-yearly terms, so that the lessons of

one term are a continuation of those which preceded. The pupils enter their names for the courses they desire to follow, but every newly-admitted pupil is obliged to attend at least four courses.

At Berlin the classes are held every Sunday from eight o'clock till one. In some places they are held morning and evening. Apprentices can only be admitted after obtaining from the corporation to which they belong, or from a Sunday school for apprentices, a certificate declaring that they are sufficiently advanced in elementary instruction. The school fee is 15 silbergroschen per quarter; but apprentices, who form the great majority of the pupils, are admitted gratuitously.

There are three schools of this kind at Berlin where the classes are held on Sundays, two of them in the buildings of the practical schools, and in the third in the Frederick Gymnasium. In the course of two half years, from Easter 1863 to Easter *1864*, the number of lessons given was 178. The average number of pupils was 1,200. With regard to age, they are classed as follows in the summer half-year :—

From 14 to 16 years.	17 to 20 years.	21 to 24 years.	25 to 30 years.	30 to 40 years.	Above 40 years.
588	485	104	31	12	3

Total - 1,223.

The total expenditure amounted to 13,609 francs.

Religious Societies for Apprentices.

Besides the elementary schools, there are in Prussia, and particularly in Berlin and Elberfeld, associations whose principal object is to keep young men in the paths of morality and religion, by offering them means of study and harmless recreations, as well as cheap lodgings and food, and aid in case of illness. The societies have small libraries, class-rooms for reading, writing, arithmetic, drawing, history, singing, and explanations of the Bible. There are lodging-houses called *Christian inns*, which receive young workmen with the approbation of the pastor of the house. The hours for rising, for prayers, and for coming in at night are fixed. The price paid for lodging is 25 c. a night, and there is a tariff for the food.

Workmen's Societies (*Handwerkerverein; Arbeiter-verein*).

There are in Prussia a great number of societies of workmen already engaged in trades. The programmes of the courses given

in these societies are generally drawn up so as to be applicable to particular trades. In most instances they comprise arithmetic, elementary geometry, the elements of projection, and especially drawing.

The pupils are usually classed under the following heads :—

1. Construction of buildings—masons, stone-cutters, marble-workers, &c.

2. Carpenters, joiners, cabinet-makers, &c.

3. Workers in metal, mechanicians, locksmiths, tinmen, iron-plate workers, coppersmiths, &c.

4. Various trades.

Albums of models corresponding to these same divisions are also published.

In most cases these courses, intended specially for workmen, are annexed to the trade schools (*Gewerbe Schulen*) and to the practical schools, which will be now described.

Trade Schools (*Gewerbe Schulen*).

This title is sometimes applied in Germany to establishments almost distinct and of a quite different order. In the Grand Duchy of Baden it is used to designate schools frequented in the morning by apprentices, and in which efforts are made to give them elementary instruction especially applicable to their trades. The usual object of the trade schools of Prussia is to train commercial assistants, masters and foremen for manufactories, and to prepare candidates for the polytechnic institutes. The studies generally extend over two years, and religious instruction is always included. The school fees are everywhere very moderate, and a great number of pupils are admitted gratis ; these establishments are consequently a considerable expense to the towns and to the State, which share the burden between them.

In 1860 there were in the kingdom of Prussia 25 trade schools distributed, somewhat unequally, as follows :—

Rhenish provinces	7	trade schools.
Westphalia	5	„ „
Silesia	3	„ „
Prussia proper	3	„ „
Pomerania	2	„ „
Brandenburg	2	„ „
Posen	3	„ „
Total	25	

These schools are established in the towns of Cologne, Königsberg, Dantzic, Stettin, Aix-la-Chapelle, Crefeld, Elberfeld, Pots-

dam, Halle, Erfurt, Frankfort, Coblentz, Munster, Gorlitz, Halberstadt, Trèves, Stralsund, Liegnitz, Schweidnitz, Iserlohn, Bielefeld, Gradenz, Saarbrück, Hagen, and Bochum. The total number of professors is 87.

According to the returns supplied by the Ministry of Commerce there were, in 1857, 1,174 pupils, and in 1858 the number had increased to 1,418, which gives an average of 57 pupils for each school. The distribution is not uniform among all the schools, and the most numerous attendances are at Königsberg, Dantzic, Gradenz, and Trèves.

Every provincial trade school consists of two classes, each of one year; a lower class and an upper class. The former is chiefly intended for theoretical instruction and drawing, the second for the application to industry of the knowledge acquired.

To be admitted to a school the candidate must be at least 14 years of age; he must be able not only to read German fluently, but also to explain, when reading, any book within the capacity of a child 14 years of age; he must write German without gross faults of spelling, and in a legible hand; he must know how to calculate in whole numbers and vulgar fractions, with their application to the solution of ordinary questions, such as measuring the superficies of polygonal planes and of prismatic bodies; and must be practised in drawing.

Young apprentices may, on leaving the elementary schools, prepare themselves sufficiently by attending the improvement schools. Other young men can acquire the necessary instruction at a good town school or an upper middle-class school, or in a gymnasium, as far as the fourth class.

To pass from the first class of the trade school into the second, the pupils are carefully examined on all the subjects taught; those who do not undergo this trial successfully may go through the first year's studies a second time. Pupils from other schools who give proof of sufficient knowledge in this examination will be at once admitted to the higher class.

The following is the general plan of instruction:—

Lower Class.

		Class hours per week.
Winter and summer terms.	Mensuration	4
	Algebra to quadratic equations inclusive	3
	Practical arithmetic	4
	Physics	4
	Chemistry	4
	Free-hand drawing	7
	Linear drawing	9
	Total	35

Upper Class.

		Class hours per week.
Winter term.	Higher algebra	3
	Descriptive geometry	3
	Practical arithmetic	2
	Mechanics and study of machines	3
	Chemical manipulation	4
	Mineralogy	2
	Construction and estimates	3
	Free-hand drawing	7
	Linear drawing	9
	Total	36
Summer term.	Continuation of descriptive geometry; conic sections	3
	Application of algebra and trigonometry to the solution of problems in mensuration, stereometry, and land surveying	3
	Practical calculations in the extraction of roots; logarithms and cubatures	2
	Study of machines; applied mechanics	3
	Industrial chemistry	4
	Mineralogy	2
	Constructions and estimates	3
	Free-hand drawing and modelling	7
	Linear drawing	9
	Total	36

An improvement school for workmen (*Handwerker Fortbildungschule*) is attached to each trade school, for the purpose of giving instruction to apprentices and workmen on weekday evenings and Sundays. The professors of the industrial schools are bound to teach in these improvement schools, and are remunerated according to the number of hours they are so occupied.

Each trade school has three ordinary professors attached to it; one for mathematics, mechanics, the study of machines, mechanical technology; one for the natural sciences, physics, chemistry, mineralogy, technological chemistry; and one for drawing, modelling, and details of constructions. The direction of the establishment is confided to one of the first two, and the other two take rank after him according to their years of service. The assistant professors, where there are any such, are gradually replaced by titular professors. The director of a provincial trade school has from 16 hours to 18 of teaching, and each of the other professors from 20 to 24 per week.

The 25 industrial schools of Prussia, containing only about 1,400 pupils, following a two years' course of study, turn out about 700 young men per year, prepared theoretically for an industrial

career. The three Schools of Arts and Trades in France, with their three years' course of theoretical study and practice in the workshop supply 300, better fitted at once to enter on practical life, but possessed, perhaps, of less complete and less general theoretical knowledge.

The expenditure for the trade schools of Prussia, 25 in number, amounts to the total sum of 70,015 thalers.

	Thalers.
The State contributes - - - -	23,662
The towns - - - - -	26,016
The school fees produce - - -	18,419
Interest on funds invested - - -	1,918
Total - -	70,015

The total number of pupils being in 1863 1,327, the expenditure for each is 52 thalers or 195 francs, without including the rent of the premises and the furniture, which are supplied by the towns. Of this sum, the State contributes about one-third, and the school fees one-fourth.

This expenditure for an education, which, though useful, is of a low order, given to outdoor pupils, appears to be excessive, and out of proportion with the results obtained. The reason is easily found in the small number of pupils attending most of the schools, some of them having only 12, 17, 21, 24, or 29 pupils, and at least two professors, with appliances sufficient for a much larger number. At Stralsund, for instance, where the number of pupils is 141, the expense is only 3,868 thalers, or 27·4 thalers per head; and at Cologne, where the pupils are 171, the total cost is 5,467 thalers, which is equal to 31·97 thalers per head, which sums are still very high, but far below the average. This comparison of the expenditure with the number of pupils shows that, in its anxiety to diffuse education among the working class, the Prussian government has done more than present circumstances require.

Academy of Architecture.

Under this title there exists at Berlin a school for instructing:—

1. Assistant engineers for the service of the State and of towns.
2. Architects and civil engineers for the service of the State and of towns.
3. Architects for private buildings.

The instruction extends over two years, divided into four half-yearly terms, and to be admitted, candidates must produce a certificate of satisfactory studies in a gymnasium or a practical school.

Candidates for the title of architect for private buildings (*Privat Baumeister*) must also have been admitted as competent

workmen in one of the trades of mason, stone-cutter, or carpenter, after three years' practical apprenticeship. To prepare for obtaining the title of architect for Government works (*Baumeister*) the candidate must have a certificate of advanced studies in a gymnasium or practical school, have passed a year in the practice of building, have a knowledge of levelling and measuring, and must also produce specimens of his drawings. As for the assistant engineers, they are sent by the Government and destined for the public service.

Every pupil on entering pays a matriculation fee of 10 thalers, and receives a paper indicating the courses he must follow, and for each of which he has to pay three-quarters of a thaler per month. The number of courses followed being seldom less than 10, the whole amounts to a yearly school fee of about 18 thalers.

The school has 23 ordinary professors and six assistants; of the first-named professors, five only are titular. They are paid at the rate of 2 thalers for an hour's lesson. The other ordinary professors are paid only $1\frac{1}{3}$ thaler per lesson, and the assistant professors 1 thaler. These salaries appear very insufficient.

In the winter of 1863–64, the Academy had 314 pupils entered for the service of the State, 34 pupils entered as private architects, 55 pupils entered as foreigners, 69 pupils, as free auditors, forming a total of 472 pupils.

The expenses amounted in 1864 to 25,975 thalers for 472 pupils, or 55 thalers per head. The school fees produced 11,500 thalers, or 44 per cent. of the expense; the Government gave 8,500 thalers, or 33 per cent. The rest was obtained from various sources.

The matters taught are distributed as follows :—

1st Year.—Elements of construction, drawings, and exercises; projections, applications to stone cutting, to vaults, &c., determination of shadows, perspective, ancient architecture.

Plans of simple buildings.

Rural constructions, projects.

Knowledge of materials and their prices.

Drawing of ornaments.

Hydraulic constructions, roads, railways.

Pure mathematics.

Applied mathematics, mechanics.

Taking of plans.

Natural sciences, elements of physics and of chemistry applied to constructions.

2nd Year.—Construction, architecture, large buildings with warming apparatus.

History of architecture.

Principal kinds of buildings, public or private.

Projects, ornaments, and decorations; free-hand drawing.

Projects of hydraulic constructions, of railways, of machine establishments.

Land Surveying.

Telegraphy.

Higher mathematics (differential and integral calculus), calculation of probabilities, analytical dynamics applied to the resistance of materials.

An examination of this well-arranged programme shows that at the end of the first year's studies the pupils may have acquired a degree of knowledge which will allow them to undertake constructions of a secondary order. The second year's course appears, so far as concerns architects, to be uselessly encumbered with the study of pure mathematics, as everything connected with the resistance of materials, and the part of mechanics which is of importance, can be taught elementarily. It moreover appears evident that the calculation of probabilities is altogether useless for architects.

On leaving the academy, the pupils are admitted to undergo examinations for the purpose of obtaining a diploma for the profession they have chosen. The candidate for the title of public architect (*Baumeister*) must be able to prove that he has worked for two years under the direction of an architect, and give an account of how he employed his time. He next prepares in strict seclusion, the project of an architectural construction, for which he is allowed a week. If these preliminary ordeals are satisfactory, he is admitted to pass the examination, which extends over two or three days, on the matters in the two years' curriculum. The certificate delivered after this examination specifies the branch the candidate intends to follow.

To obtain the title of private architect (*privat Baumeister*), the candidate must be a master in one of the trades of mason, carpenter, or stone-cutter, and give proof of three years' preliminary studies. He must draw up a project, for which a week is allowed. He next passes the examination, occupying two days, on all the subjects taught.

Assistant engineers are not examined; it is considered sufficient to take note of the manner in which they have pursued their studies. They have to take an oath.

An annual and optional competition is held every year between the pupils, and the author of the best projects receives a subvention of about 2,000 frs. for travelling abroad.

The instruction given in this school appears to be organized on a good method; it makes the pupils proficient in all the details of building as well as in the principles of the art, and is not satisfied with training decorators merely.

Academy of Mines (*Berg-Akademie*).

This academy, founded in 1861, is designed to impart to young men who intend to enter the public service of mines, or to pursue the industry of metallurgy, the knowledge of the applied or technical sciences which may be necessary. The theoretical instruction bearing on these sciences is given to the pupils in the university of Berlin. The mining pupils who wish to enter the service of the State have three degrees to acquire by examinations. The first, which is given on leaving the school, is that of pupil of mines (*elève des mines*). The second, which can only be

obtained after two years' practical working, leads to the title of auditor of mines (*référendaire des mines*). The third, for which no one can present himself till after two years past in administrative works under a chief engineer, gives the title of assessor of mines.

The school fees are calculated at the rate of 1½ thal. for an hour's lesson attended per week. Thus a pupil who attends a course for which there are six hours' lessons per week, pays 9 thalers per half yearly term. For manipulations in the laboratory, they pay in addition 20 thalers per term, and 10 thalers if they practise assaying.

The number of pupils varies from 30 to 40, and the total expense of the establishment amounts to 12,000 thalers. The amount not covered by the receipts is paid by the Government, which has also found the building, and all its furniture, as well as the collections. The courses may be attended by persons not belonging to the school, but they, like the regular pupils, inscribe their names for the course they intend to follow.

There are in all nine professors, three of whom are specially attached to the school, and receive each 1,000 thalers a year. The director has the same salary. The other professors belong to the university, and attend to give lessons at the academy.

The laboratories are commodious and very completely organized. There are separate ones for assaying by the humid and by the dry method. The costly re-agents are given out only by the professor; the others are placed freely at the disposal of the pupils. The geological and mineralogical collections are very fine, and very complete. Their classification is nearly finished. Part of them are placed at the disposal of the pupils for their studies.

INDUSTRIAL DRAWING SCHOOL (*MUSTER ZEICHNEN SCHULE*).

This school is considered as a branch of the Polytechnic Institute, though really it is quite distinct, and has a director of its own. The purpose of it is to form designers and composers for textile fabrics in silks, woollen, or cotton, for printing tissues, and also producing patterns for paper-hanging; and, for this reason, it much more nearly approaches the Weaving Schools properly so called. Besides drawing, the theory and practice of weaving in all their details is likewise taught. The school has eight or ten looms.

The method adopted here for teaching drawing is that of the late M. Dupuis, which consists, in exercising the pupils from the very first in drawing only from models in relief, graduated from the simplest to the most complicated. The results of this teaching are truly remarkable for all the branches of industry to which they belong; but unfortunately the pupils it trains cannot easily find in their own country the means of utilizing their talents, and the majority of them consequently go abroad; so the school which at first flourished, and had from 40 to 50 pupils, has not at present more than six or eight, and its suppression has even been mooted.

The course of instruction extends over two years. In the first year, or second class, the pupils devote every week :—twenty-four hours to drawing from models in relief; four hours to instruction in physics and chemistry suited to the object of the school; and four hours to industrial drawing. In the second year, or first class, the pupils are engaged every week :—thirty-six hours in the composition and execution of designs for prints and figured tissues; sixteen hours in the making ready of looms for quiltings, velvets, and practice in weaving; eight hours in the decomposition of tissues and preparing the cards for weaving them.

To be admitted to the school, candidates must be 14 years old at least, and have been confirmed or taken their first communion. They must be able to read the German language both in the black letter and in Roman characters, and to give a summary of a book suited to their intelligence. They must be able to calculate in whole numbers and vulgar fractions, and to solve ordinary problems. They must write German without any gross faults of spelling, and must know the rudiments of drawing.

The school fee is 12 thalers per half year. The object of the school is to train designers, who, after attending the complete course of studies, shall be able to draw patterns for manufacturers, or to take the management of workshops for drawing.

Instruction is also given in drawing patterns for paper-hangings, for oil-cloths, for silk, cotton, woollen, or linen prints, for the weaving of figured stuffs and ribbons, for upholstery fabrics, carpets, embroidery, and lace.

The course of industrial drawing, properly so called, commences with the copying of flowers from nature; then select drawings are copied; and no pains are spared to accustom the pupils to composition, that is to say, *the invention of* new patterns.

During the vacations of each year there is an exhibition *of the* pupils' drawings. Part of the drawings executed by the pupils belong to the establishment, the rest are returned to them. The pupils whose instruction is satisfactorily completed receive a certificate of maturity; the others may obtain a certificate indicating the extent of their special instruction.

Navigation Schools.

There are in Prussia six navigation schools intended to educate young men as mariners and masters of merchant vessels. They are situated at Memel, Dantzic, Pillau, Grabow, near Stettin, and Stralsund. A single director, residing at Dantzic, has the superintendence of all these schools, which have each two professors, and an assistant professor to teach drawing. There are two divisions in the schools. The lower one gives, in one year, the instruction necessary for pilots; the higher one, in two years, teaches the art of navigating the high seas.

Admission to these schools is decided after an examination by a professor in presence of the director. To be received for the course of pilotage, the candidate must be under 40 years of age,

able to read, write, and compose passably in German, and also be versed in elementary mathematics. The school fee is 10 thalers for the navigation division, and 6 thalers for the pilots' class quarterly in both cases. There are 32 hours' lessons per week.

The subjects taught in the pilotage division comprise :—Arithmetic, plane geometry, carpentry, plane and spherical trigonometry, navigation, terrestrial and astronomical observations, drawing of sea-charts and astronomical maps, and the English language. The curriculum of the higher division comprises, besides the preceding which have to be carried farther, rigging, drawing the differents parts of a vessel, the commercial rules relative to ships' papers, and to the course of exchange at the principal commercial ports, &c.

A certificate of efficiency is given to those pupils who pass a satisfactory examination on leaving the school.

Practical Schools.—(*Real Schulen.*)

Under this title are included those establishments, very numerous in Germany, where young men intended for trade, the lower posts in government offices and manufacturing houses, receive a general education. In Prussia the courses comprise the German, English, and French languages, and sometimes Italian. Greek is not taught, but often enough Latin to procure admission into the upper classes of the gymnasia where the classics are studied, and also into the polytechnic institutes. It includes also religious instruction, history, geography, the elements of natural history, physics, and chemistry, commercial arithmetic, elementary geometry, singing, and gymnastics. The schools are attended by a large number of pupils, all day scholars.

These practical schools are divided into higher and lower; the other schools called upper middle-class schools (*Höhere Bürger-Schulen*), are sometimes classed with them, though they give a somewhat inferior education. The lower practical schools have only three or four classes, the higher six or eight, among which are included those of the preceding. The instruction is so graduated that these schools can receive boys as early as seven or eight years of age, provided they can already read, write, calculate, and have learned German grammar and orthography. These qualifications often require one or two years of preparatory classes or in all eight years' attendance, so that a youth may have terminated his studies by his 17th or 18th year.

The study of modern languages is very extensive, and comprises for the higher classes the German authors in prose and verse, and for Latin the prose writers only, so as to enable the pupils to attend certain courses in the university to which they are admitted with the pupils of the gymnasia. The instruction in science is such as to prepare boys for the industrial schools and for the polytechnic institutes.

Taking the programme for the pupils of the six classes in the higher division of the practical school at Elberfeld as an example,

the time devoted to the different lessons in each week and for the six classes is as follows :—

	Hours.
Religious instruction	12
German language	16
Latin (for pupils going to the gymnasia)	34
French	32
English	9
Geography	8
History	11
Natural history	8
Caligraphy	7
Arithmetic and commercial calculations	19
Physics	6
Chemistry	4
Geometry	11
Singing	7
Gymnastics	12

The practical schools in Prussia being chiefly intended for youths who are preparing for trade, manufactures, and the lower clerkships in government offices, it always happens that a great many of the pupils leave school after passing through the third or fourth class, and only a small number remain for the second, and still fewer for the first. As a general rule, the number of pupils in the second class is at most only half that of the sixth, fifth, fourth, and third, while the proportion in the first is not above one-tenth. This fact shows that the practical schools are not frequented by those who desire a high literary education, even when limited to the living languages, though these are taught there more efficiently than in the gymnasia. Still less do they offer technical instruction bearing more or less directly on industry. In other parts of Germany the same name is given to establishments of a very different kind.

The institution of the practical schools is already of rather old date, for that of Elberfeld was founded in 1829 by the municipal council of that town with the authorization of the Government, which placed it under the supervision of the regency of Düsseldorf and of a committee consisting of seven members, presided over by the director who is appointed by the Government. Three of the members are elected by the municipal council, and the three others by the regency of the province.

All the schools of this kind existing in Prussia are under the general direction of the Ministry of Public Instruction, which, however, leaves the local committees full liberty to adapt the teaching, (the expense of which is to a great extent borne by the towns,) as far as possible, to local requirements, but without making it technical. At the period of their foundation an effort was made to give part of these schools a more technical direction, but it could not be either sufficiently scientific or sufficiently practical to attain the end desired, and the results were anything but favourable. All now limit their studies to modern literature and to the general elements of the sciences.

The following is the distribution of the lessons given during the week, adopted at most of the schools.

Matters taught.	6th Class.	5th Class.	4th Class.	3rd Class.	2nd Class.	1st Class.	Total per Week.
Religion - - -	3	3	2	2	2	2	14
German - - -	4	4	3	3	3	3	20
Latin - - - -	8	6	6	5	4	3	32
French - - -	—	5	5	4	4	4	22
English - - -	—	—	—	4	3	3	10
Geography and history -	3	3	4	4	3	3	20
Natural history - -	2	2	2	2	6	6	20
Mathematics - -	5	4	6	6	5	5	31
Writing - - -	3	2	2	—	—	—	7
Drawing - - -	2	2	2	2	2	3	13
Total of hours' lessons per week.	30	31	32	32	32	32	—

This general programme, which may be regarded as the type of the instruction given in these schools, is subject to some few partial modifications, and it may be more extensive in certain towns; but the spirit and object of the teaching are always the same.

For the reproach addressed to these schools that they have materialistic tendencies, there seems to be at present no foundation, nor has there ever been any in time past. Religious instruction, calculated to strengthen the sentiments developed in the primary schools, has never ceased to be imparted as far as the third and fourth classes. The literary studies comprise the very same authors as are used in the gymnasia, omitting those of Greece and Rome; they cannot therefore have produced the result which has been imputed to them. Generally it may be said that in Prussia as well as throughout Germany, the education given in these practical schools is remarkably good. Besides a literary preparation sufficient for commercial careers amply, liberally, and often gratuitously placed within the reach of the most moderate fortunes, these schools successfully diffuse the knowledge of living languages, French, English, and Italian. They prepare for the Polytechnic institutes candidates well grounded in the German language, and not unfrequently in other modern idioms. Simple in their scientific exposition, aided by collections as extensive as circumstances require, conducted by professors who know how to adapt their teaching to the requirements of their pupils, and completely distinct from the system of the gymnasia, which is and ought to be far more doctrinal, these schools fulfil all the conditions of an education especially destined for tradesmen and manufacturers.

The school fees are rather low, and vary, according to age and class, from 35 to 40 thalers a year. But as there are a great number of non-paying pupils the receipts are far from covering

the expenditure of these establishments, and the deficiency, amounting to between one-third and one-half of the whole, is usually defrayed by the towns. All the practical schools have a library, a gallery of instruments for physics, a chemical laboratory, drawing halls, with numerous models, and are very fairly provided with all the necessary appliances.

Practical School of Berlin (*Königstädtische Real-schule.*)

The studies of this school, which is one of those where the instruction is most extended, are divided between the elementary classes and what are called the "real classes." The first classes, four in number, comprise two years' study, during which the teaching religion, the German language, writing, and arithmetic. The pupils may be admitted as early as seven years of age, provided they can already read, write, and know a little of arithmetic. The classes in which the higher course of instruction is given are six in number, according to the classification, but they require in reality eight years of study. The first, which is a class for modern languages, must be doubled, and therefore requires two years. The second and third are divided into lower second and third and higher second and third, which occupy each one year. The fourth and fifth also take a year each. The sixth and seventh alone require only half a year each. This arrangement of the studies, therefore, extends over nine years, which, added to the two elementary years imposed on a boy entering at seven years of age, will not allow him to complete his studies until he attains his eighteenth year, if he wishes afterwards to enter the Polytechnic institutes. The programme of this school is analogous to that of the Elberfeld school, but somewhat more extended. The number of hours per week devoted to the same subject in all the six classes is as follows:—

Religion	12	hours per week for the six classes.
German	27	" "
Latin	42	" "
French	31	" "
English	17	" "
History	16	" "
Geography	12	" "
Geometry	16	" "
Arithmetic	25	" "
Physics	8	" "
Chemistry	10	" "
Natural history	15	" "
Drawing	17	" "
Writing	7	" "

It is evident from the above that in these schools the religious instruction given in previous years is carefully continued, and that the study of Latin and of the living languages occupies the greater part of the time. It is worthy of remark that more hours are allotted to the study of French than to that of German,

and nearly twice as many as to English. It will also be observed that this instruction has nothing technical or special to any particular branch of industry. It only imparts general and, for the most part, literary knowledge.

The division of the pupils into the different classes further shows that the number of those who go so far as the second class is barely one half that of the pupils of the third and fourth. Many leave school after these last-named classes to enter on the business of life when 14 or 15 years of age. As for the pupils of the first class their number is rarely above one-eighth or one-ninth of the fourth class. The numbers of pupils who attended the different classes in the winter and summer half years of 1862 were as follows:—

	Winter.	Summer.
First	12	10
Second (upper)	13	15
Second (lower)	30	38
Third (upper)	78	63
Third (lower)	77	82
Fourth	110	112
Fifth	94	95
Sixth (upper)	55	59
Sixth (lower)	53	59
Two elementary classes	214	201
Total number of pupils	736	734

Practical School of Wittstock.

This school comprises two elementary classes and six higher classes each requiring a year's study. The distribution of hours of lessons per week is regulated for the six higher classes very nearly in accordance with the general type already given, as will be seen from the following table:—

Religion	14 hours per week.
German	17 ,,
Latin	32 ,,
French	22 ,,
English	10 ,,
History	10 ,,
Geography	8 ,,
Geometry	16 ,,
Arithmetic	20 ,,
Physics	6 ,,
Chemistry	4 ,,
Natural history	8 ,,
Drawing	13 ,,
Writing	7 ,,
Singing	12 ,,

In this school, as in those already noted, the majority of the pupils leave after the third or fourth class. During the winter of 1860–61, the 247 pupils of the Wittstock school were thus distributed:—

First class	3	pupils.
Second	12	„
Third	27	„
Fourth	36	„
Fifth	43	„
Sixth	42	„
Two elementary classes	84	„
Total	247	„

Upper Middle-Class Schools (*Höhere Bürger-Schulen.*)

Besides the practical schools, properly so called, of which we have just described the object and organization, there are also in Prussia, as already stated, a certain number of schools of the same kind, but having a curriculum somewhat less developed, which retain the old name of *Höhere Bürgerschulen*. They are under the direction of the Ministry of Public Instruction. The education given is literary and scientific without any technical applications.

The number of the practical schools in Prussia (including the 21 upper middle-class schools) is 86. In 1864 they were attended by 20,732 pupils, taught by 987 professors. The total cost to the State was 635,785 thalers.

The Gymnasia.

These establishments, analogous to the French institutions for secondary instruction, are intended to give a classical education. The principles of religion, the German language, French, Latin, Greek, Hebrew, history, geography, elementary mathematics, physics, chemistry, singing, and gymnastics are comprised in the studies. Drawing is not included. Most of the pupils afterwards attend the universities. There are six classes, besides a preparatory school for the youngest and least advanced pupils.

The regulations forbid the admission to the sixth class of boys under nine years of age. Supposing, therefore, that a boy has not to go twice through one class, he may complete his literary studies by his fifteenth year, and be, at that age, admissible to the universities and polytechnic institutes. When the number of pupils in a class exceeds 50, it is divided into two. At the end of their studies the pupils who intend to enter the universities must undergo an examination, to obtain the necessary certificate of maturity. These examinations are very strict, and rarely more than half the pupils obtain the certificate. In 1862–63 the pupils

in the Elberfeld gymnasium were divided among the different classes in the following proportions:—

	1st Class.	2nd Class.	3rd Class (2 Sections).	4th Class (2 Sections).	5th Class.	6th Class.	Preparatory School.	Total.
Winter term	31	41	64	58	41	33	25	293
Summer term	31	36	59	58	43	38	25	290

Out of the 31 pupils of the first class, 14 only obtained the certificate of maturity, and of this number eight intended to devote themselves to theology, two to medicine, and two to law.

Polytechnic Institute.

The name of Royal Trade Institute (*Königliches Gewerbe Institut*) is given, at Berlin, to an establishment analogous, as to its object and the instruction given, to those which throughout Germany are called polytechnic institutes. The pupils are, according to the profession they intend to follow, separated into three divisions, viz.:—1, one for mechanicians; 2, one for chemists and metallurgists; 3, one for shipbuilders. The course extends over three years. The first three half-yearly terms are employed in general theoretical studies common to the three divisions. The number of pupils at the time of our visit was 350. The school fee is 40 thalers a year for the first and third division, and 50 thalers for the second division (chemists). But two-thirds of the pupils are admitted gratuitously, and some 20 of them receive also a grant of 200 thalers a year for their subsistence at Berlin.

The establishment has a staff of 22 professors, whose salaries are regulated according to the number of lessons they give per week, at the rate of 100 thalers the hour's lesson given per week. Thus, a professor who gives regularly ten lessons a week, in the course of the school year, receives 1,000 thalers. Owing to this low rate of payment, the majority of the professors are obliged to give lessons in other establishments in order to eke out their income.

Workshops in which artisans are employed in making and repairing models are open to the pupils; but they are seldom visited. Some few pupils, however, profit by them; but the majority of these are practical workmen. There are very complete and well-organized laboratories for the chemical pupils, large enough to accommodate from 45 to 50 at once. Tables with cupboards and shelves on which the re-agents are arranged receive each six pupils. Glazed and closed stoves, with gas-burners, sand-stoves, all well closed and ventilated, serve for evaporating.

Drawing is taught by the Dupuis method, that is, by habituating pupils from the very beginning to draw from models in relief. A workshop for modelling is annexed to the drawing class rooms, provided with a very fine collection of models of ornaments and of the plastic art. There is room for above 30 pupils, and the attendance is numerous.

A library of 100,000 volumes is open to the pupils, and to the public in general. There are also very complete collections of models of machines and of instruments used in the study of physics, all accessible to the pupils and to the public.

Every candidate for admission must not be younger than 17, nor older than 27. He must have a certificate of maturity from a practical school, a gymnasium, or a provincial industrial school.

The institute has a first division of general technical instruction, and a second division comprising the three specialties, mechanics, chemistry and metallurgy, and naval constructions. In the first division the instruction is purely theoretical. In the second, after the lessons, the pupils proceed to practical exercises in the class-rooms and laboratories. The duration of the studies in each division is a year and a half, and none can enter the second division without having attended all the courses of the first. Those pupils who intend to become shipbuilders must have worked at least six months in a building yard. Mechanicians are allowed, after completing their three years' studies, to remain another year in the workshops of the establishment.

The general technical instruction of the first division comprises the higher branches of arithmetic and algebra; spherical trigonometry with its applications; the differential and integral calculus; statics and analytical mechanics; the theory of the mechanical effects of heat; descriptive geometry with its practical applications; mineral chemistry; physics; general experimental chemistry; general course of construction; simple mechanics; free-hand drawing and modelling. In the second division the class of mechanicians is taught the theory of resistance of materials; the theory of vaults and of the stability of abutments and retaining walls; the motions of air and water in natural or artificial channels, hydraulics; the theory of heating apparatus; the general theory of machines, and of prime movers; mechanical and chemical technology; projects of machines, and the mathematical demonstrations of the essential principles of physics. The class for chemists is instructed in mineral, organic, technological, and metallurgical chemistry, mineralogy, physical geography; special study of machines and prime movers; projects of chemical works; and manipulations in the laboratory. The class for shipbuilders is taught the drawing of ships and parts of ships, construction, measurement and stability of vessels; hydrostatics; the theory of sailing and steam vessels in wood and iron.

On leaving, the pupils receive a certificate signed by the council of professors, stating their proficiency in their different studies. The school fee is 20 thalers per half year, and 45 thalers for those

who take part in chemical manipulations. The latter are also bound to pay for all breakages caused by their negligence.

Generally, all the information collected respecting the organization of instruction in Prussia shows that during the last forty years the Government has made the most liberal efforts to extend and diffuse the education required by the different classes of the community. Primary instruction has been made general and improved, the middle-class schools, the industrial schools, the special weaving schools, the practical schools, the schools of architecture, of mines, and of navigation, the gymnasia, the polytechnic institutes, and lastly, the universities, form a complete whole, amply sufficient for the present requirements of public instruction. Perhaps the grants made by the State have exceeded what was really necessary; but this redounds to the credit of the Government and of the ministers, who, as true friends to science and industry, have originated these measures.

REPORT ON THE ORGANIZATION OF TECHNICAL INSTRUCTION IN THE KINGDOM OF SAXONY.

General System of Instruction in Saxony.

Primary Instruction.—The principle of compulsory instruction appears to have been established in Saxony by the Elector John George in 1573, since which time it has been enforced with more or less severity. Its application is now regulated by the law of 6th June 1836, which requires the attendance at school of children of both sexes between the ages of six and 14 years. The expenses of the primary schools are defrayed in part by the school fees, from which the poor only are exempted, the deficiency being supplied by local taxation, and by grants from the Government in the poorer districts.

The annual sum contributed by the State is only 110,000 thalers, of which 52,000 thalers are given to the parish schools, and 58,000 for maintaining normal schools for teachers of both sexes. The primary schools of Dresden cost 99,000 thalers, 53,000 of which are obtained from the school fees, and the balance of 46,000 from the town.

Sunday Schools.—Besides the primary schools, every parish has its Sunday schools, and in the towns there are evening schools to complete elementary instruction. The subjects taught in these establishments are, the German language, drawing, the elements of geometry and mathematics, and in some cases the rudiments of physics and chemistry. The State grants to these schools amount to 12,000 thalers.

Apprentice Schools for Girls.—In the villages of the mountainous and poorer districts, apprentice schools for girls have been established in which lace-making, knitting, &c. are taught.

The parishes supply the premises, firing, and lighting; the Government pays the teachers, and also gives 4,500 thalers towards the other expenses. These schools are under the supervision of inspectors.

Instruction of Children who work in Factories.—Children cannot be employed in factories until they are 12 years old. Their employers are bound to allow them the time necessary for attending the primary school, or else to have a school on the premises as required by the provisions of the law of 6th June 1835. Children under 14 years of age must not be kept at work more than 10 hours, including the time allowed for meals.

Gymnasia and Practical Schools.—In large towns, such as Dresden, Leipzig, and Chemnitz, the gymnasia and the practical schools are exclusively local burdens. Other gymnasia have endowments of their own. The sum of 50,000 thalers voted in the educational budget is intended for the support of the gymnasia and practical schools of smaller towns, such as Zwickau, Freiberg, Zittau, Plauen, Annaberg, &c., 11 in number. Besides the 90,000 thalers inserted in the budget, the university possesses landed estates, endowments, and Government stock producing 80,000 thalers yearly, so that its total revenue is 170,000 thalers.

Technical Schools.—The special or technical schools, which are of recent foundation, and depend on the Ministry of the Interior, have no revenues of their own, and all their expenditure in excess of the school fees is paid by the State.

Relative Proportions of the School Fees and the Expenditure.—In general the school fees are very low, and, many pupils being exempted from payment, the amount covers but a small part of the expenses, as will be seen by the following table:—

——	Total Budget.	Amount of School Fees.	Proportion.
	Thalers.	Thalers.	
Polytechnic school - - -	30,000	7,000	0·23
School of Arts and Trades - -	18,000	4,000	0·22
School of Fine Arts - - -	22,500	1,500	0·07
School of Forests - - -	16,500	4,500	0·27
School of Mines - - -	14,800	1,200	0·08
School of Master Builders - -	—	—	—
School of Foremen - - -	13,750	1,750	0·13

Schools for Master Artisans.—There are five schools for master masons and carpenters (*Baumeister*) maintained by the State. Their courses extend over three winter half-years. There is also a school at Chemnitz for foremen of mechanical engineering workshops and of spinning factories, the courses of which extend over three winter terms. There are also four schools for pilots and boatmen which are held from December to February; they are situated in small towns on the banks of the Elbe. The total cost of all these schools amounts to 14,500 thalers.

The Professional Schools are more advanced than the primary and Sunday schools: such schools of different degrees, beginning with those of the lowest order, and intended to impart the instruction necessary for overseers and foremen in workshops, have been established in several manufacturing towns. As examples of all these educational institutions a short description of several of the schools at Chemnitz is here given.

The Chemnitz School for Master Artisans (*Werkmeister Schule*).

This school is composed of three classes. In the year 1862–63 the subjects taught and the number of hours per week devoted to each were as follows:—

Subjects taught.	3rd Class.	2nd Class.	1st Class.
German language	4	—	—
Arithmetic and elements of algebra	7	—	—
Geometry	5	—	—
Free-hand drawing	4	—	4
Geometrical drawing	8	—	—
Elements of physics	4	—	—
Mathematics and mechanics	—	8	4
Description of machines and technology	—	6	6
Machine construction	—	2	2
Machine drawing	—	8	8
Building construction	—	4	—
Hydraulic machines (optional)	—	—	4
Book-keeping	—	—	2
Spinning and weaving (optional)	—	—	4

The teaching of arithmetic includes the elements of algebra. That of geometry, in addition to the elements, comprises its application to the making of plans, land surveying, and projections. In mechanics the gauging of watercourses and the construction of machines are taught elementarily and from an essentially practical point of view, with applications to the local manufactures. Free-hand drawing is taught by the Dupuis method, and by the execution of a great number of sketches. Under the head of building construction is included a special study of the details of framing, and of the execution of constructions in wood and iron.

The instruction being essentially technical and practical, appears to completely answer the end in view. In the year 1862–63 this school had 49 pupils and eight professors; among the latter were two doctors in philosophy, one of whom taught mathematics and was well able to adapt his lessons to the capacities of his pupils.

School of Builders (*Baugewerbe Schule*) at Chemnitz.

The object of this establishment is to give to persons employed in the building trade instruction in subjects bearing on that trade;

it is divided into three classes and the course occupies three years. Pupils to be admitted must have acquired mathematical knowledge as far advanced as that taught at the schools for master artisans.

The following is the list of subjects and the number of hours per week allotted to each :—

Subjects taught.	3rd Class.	2nd Class.	1st Class.
German language and literature	4	2	2
Arithmetic	7	—	—
Geometry and projections	5	2	4
Mechanics	—	4	2
Free-hand drawing	—	—	—
Linear and perspective drawing	4	2	2
General constructions.—Knowledge of materials	4	2	—
Architectural drawing	6	4	—
Drawing of ornaments.—Styles	2	4	4
Physics	4	—	—
Constructions.—Details	—	4	4
Projects of constructions	—	4	8
Drawing up of estimates	—	—	2
Modelling of voussoirs	—	—	6
Total	36	28	34

The number of pupils in this school in the year 1862–63 was 84, of whom 46 were in the first class, 21 in the second, and 17 in the third.

At the end of the courses there are examinations, and certificates of capacity are delivered to those who pass them satisfactorily. A careful examination of the programme shows that the technical instruction is given to a sufficient extent, and that the study of pure science is kept within proper bounds.

The Chemnitz Royal Upper Trade School (*Hoehere Gewerbe Schule.*)

This establishment was authorized by a royal decree, dated 9th October 1862, to assume the above title. The teaching extends over three or four years, and is distributed in three special divisions.

The first A, relating to technical industries, is subdivided into two sections, of which the first, A^a, is devoted to the construction of manufacturing machines, especially those for spinning; the second, A^b, is intended for manufacturers whose business requires applications of chemistry and of mechanics. The studies of the A division occupy three years.

The second division, B, consists of pupils who require only a practical acquaintance with the chemical arts, such as dyers, soapmakers, printers in colours, &c. This division also has three years of study.

The third division, C, is intended for agriculturists, and the studies are completed in three years.

The following is the programme of the studies:—

Fourth class.—Arithmetic and algebra as far as equations of the first degree (four hours per week); plane geometry (four hours); physics (four hours), natural history (four hours); free-hand drawing, by the Dupuis method; linear drawing; German language (four hours).

Third class.—(Divisions A, B, and C.)—General chemistry (four hours in summer, six hours in winter); German language (four hours).

(Division A[a].)—Arithmetic and algebra to equations of the second degree; geometry; physics; descriptive geometry; free-hand drawing; commercial arithmetic.

(Division B.)—Mechanical technology; chemical manipulations.

(Division C.)—Arithmetic; geometry; physics; botany; zoology, mineralogy (four hours in winter); knowledge of machines and technology; drawing of machines, land-surveying, and plotting; commercial arithmetic, book-keeping, and correspondence; drawing of plans.

Second class.—(Divisions A, B, and C.)—German language and literature (four hours).

(Division A.)—Higher arithmetic and algebra; spherical trigonometry, analytical geometry; mechanics; machine drawing; descriptive geometry (four hours); practical geometry; land-surveying and levelling, with the actual use of the instruments in the field (half a day weekly); mechanical technology; mineral and technical chemistry, chemical manipulations, and the applications of chemistry to the industrial arts.

(Division B.)—Technical chemistry (six hours); manipulations (twelve hours); mineralogy, physical geogaphy, mechanical technology, and machine drawing.

(Division C.)—Physiology of plants (four hours in summer), physiology of animals (two hours in summer); practical agriculture (four hours); farm buildings; practical land-surveying, plotting, and levelling, with the use of all the necessary instruments; physical geography; agricultural chemistry; chemical manipulations.

First class.—Study of machines (eight hours); machine drawing (eight hours); mathematics (four hours); mineralogy, and physical geography; chemistry, technical, analytical, and theoretical; chemical manipulations (four hours); constructions (two hours); mechanical technology; French and English languages (each three hours per week); book-keeping and commercial correspondence (three hours); history and geography (three hours).

Attached to this establishment there is a drawing school for apprentices and workmen employed in the town. It is divided into two classes, which are held four hours weekly.

Practical Schools.

The schools thus designated in Saxony are like those in Prussia, devoted chiefly to teaching the mathematical and physical sciences,

drawing, and the living languages (German, French, and English); but little time is given to Latin, and Greek is altogether excluded. The curriculum is well adapted for preparing pupils to enter the polytechnic institutes.

The present organization of these schools, which all depend on the Ministry of Public Instruction, was fixed by a royal decree dated the 2nd July 1860. The director and professors of each school are appointed by the minister, and a regular system of inspection is established. Pupils are not admitted under 10 years of age, and they must have acquired the instruction given in the primary schools. The pupils are divided into six classes; as a general rule, the number in each class must not exceed 40.

There are two examinations yearly at Michaelmas and Easter; the former is not public, being merely intended to stimulate the zeal of the pupils, and determine their place in the classes. The examinations are both oral and written, the former being a general repetition of what has been taught during the half-year.

The written tests for the first class are:—1. A composition in German. 2. A composition in French; (The subject for these compositions is communicated a fortnight beforehand.) 3. A translation from German into English. 4. A translation from German into Latin. 5. The solution of a geometrical problem. 6. The solution of an arithmetical problem. 7. The solution of a problem in physics. For each of the first five tests the pupils are allowed three hours, under the supervision of a professor. Prizes are given to the most deserving.

The vacations are a fortnight at Easter, three weeks at Whitsuntide, and a week at Michaelmas. The following table shows the number of hours devoted per week to each subject of instruction:—

Subjects of Instruction.	1st Class.	2nd Class.	3rd Class.	4th Class.	5th Class.	6th Class.
	Hours.	Hours.	Hours.	Hours.	Hours.	Hours.
Religion - -	2	2	3	3	4	4
German - -	3–4	3–4	3	4	4	4
Latin - -	3	3	3	3	4	6
French - -	4	4	4	7	6	–
English - -	3	3	4	–	–	–
Geography -	2	2	2	2	2	2
History - -	2	2	2	2	2	2
Natural history -	1	1	2	2	2	2
Physics - -	2	3	2	–	–	–
Chemistry -	3	2	–	–	–	–
Arithmetic -	1	2	2	4	4	4
Algèbra - -	3	3	3	–	–	–
Mathematics -	3	3	3	2	–	–
Drawing - -	2	2	2	2	2	2
Caligraphy -	–	–	–	1	2	2
Singing - -	1	1	1	1	1	1
	35–36	36–37	38	38	33	29
Gymnastics -	2	2	2	2	2	2

At the close of their studies pupils may present themselves to be examined in order to obtain a certificate of maturity. The Board of Examiners is composed of the director, and all the professors of the subjects in which the examination is held, and is presided over by a Commissioner appointed by the Minister of Public Instruction. To be admitted, a pupil must have attended the lessons of the higher class of a practical school; young men educated in other establishments or at home must produce certificates of study.

The examination is gratis for pupils of the school where it is held; all others have to pay a fee of six thalers whether successful or not. It consists of written and oral tests; the written, which come first, consist of—1. A composition in German. 2. A composition in French. 3. A translation from German into English. 4. A translation from German into Latin. 5. A problem in plane and solid mensuration. 6. A problem in trigonometry. 7. A problem in algebra. 8. A problem in physics. The subject of the German composition and the problems are chosen by the directors, and that of the German is given a week beforehand, and the pupils have to certify that the composition is their own production. All the other papers are worked in the establishment under the eye of a professor, and four hours are allowed for each. The examination papers are corrected and marked by the respective professors, and then submitted to the director and the whole professorial body.

The oral examination lasts one day at most, and is not public. The notes affixed to each paper are: 1, excellent; 2, good; 3, sufficient; with intermediate notes of "very good" between 1 and 2, and "pretty good" between 2 and 3. The certificate awarded contains a list of all the subjects in which the pupil has been examined, with one or other of the above notes appended to each. If a candidate fails he may remain another year in the school, but after a second failure he cannot present himself again. Any fraud in the examinations is punished by immediate exclusion, and if not discovered till after a certificate has been given it is annulled, and the professor of the culprit is compelled to bring him up for a fresh examination.

Practical School of Neustadt.

This school is one of those which have the right to grant certificates of maturity. The director is the head professor of the first class, and the vice-rector of the second. There are 17 professors. The 1st class contains 22 pupils; the 2nd, 34; the 3rd, 60; the 4th, 79; the 5th, 69; the 6th, 49; making a total of 313 pupils. At the examination in March 1863, 11 pupils obtained certificates of maturity.

Dresden Polytechnic Institute.

This establishment, founded in 1828, underwent successive changes in its organization and system of teaching in 1832 and

1855, in which last year it was definitively constituted on its present footing, and, finally, a decree of 31st July 1863 regulated its curriculum as hereafter explained. Its object is to train engineers for the service of the State, mechanical engineers, masters and managers of factories, and also professors for teaching the sciences. The pupils are divided into four special divisions, corresponding to the career they intend to follow. Division A,—for pupils who are destined to become manufacturers, directors of factories, mechanical engineers, or professors of mechanics. Division B—for engineers of roads, railways, bridges, hydraulic works, and the Government survey. Division C—for the masters or managers of industrial establishments in which the chemical arts prevail. Division D—for pupils who wish to become professors of mathematics, natural history, and technical instruction.

It will be seen from this classification of the pupils that the Dresden Polytechnic Institute, besides training engineers for the public service and the industry of the country, also undertakes to educate professors, and thus presents the twofold character of a technical school and a normal school for this department of education. The latter object is of considerable importance inasmuch as these future professors, being trained by masters who themselves treat of the application of the sciences to arts and manufacturers, can more easily adapt themselves to the peculiar conditions of this kind of instruction than those who receive a university education. The latter may, perhaps, be more profound, but teachers trained under it are, for that very reason, often induced to employ methods of a scientific order too high for the majority of the pupils, and requiring more time than is really necessary. The instruction is divided into general and special courses. The former comprise three half-yearly terms, beginning at Easter, the second occupy three years. The general courses comprise the study of the following subjects :—

First half year.—Repetition of elementary mathematics. Spherical trigonometry. General physics and chemistry. Projections: Drawing of plans. German literature and language.

Second and Third half years.—Analytical geometry. Mechanics. General chemistry. Physics. Constructions and drawing of ditto. Projections and perspective. Land-surveying and plotting. German language and literature.

To be admitted to these general courses, the candidate must produce a satisfactory certificate from one of the practical schools of the kingdom, or from one of the third class of the Chemnitz Industrial School. Candidates who do not hold these certificates must prove that they are 16 years of age, and undergo an examination to show that they have received a sufficient preparatory education. Pupils who do not absolutely fulfil these conditions may be admitted provisionally for half a year.

The special courses of the first year are as follows in the different divisions :—

Division A.—*Mechanicians, &c.*—Higher mathematics. General mechanics. Special mechanics. Composition and projects

of machines. Technical mechanics. Materials. Mineralogy. Knowledge of stones. Architectural drawing. History of literature.

Division B.—*Engineers of Roads, &c.*—Higher mathematics. General mechanics. Technological mechanics. Mineralogy and knowledge of stones. Measuring of artificers' work. Land-surveying and topographical drawing. Details of constructions. Architectural drawing. History of literature.

Division C.—*Chemical Arts and Industries.*—Higher mathematics. General mechanics. Technological mechanics. Mineralogy and knowledge of stones. Technological chemistry. Theoretical chemistry. Chemical manipulations. Architectural drawing. History of literature.

Division D.—*Teachers, &c.*—Higher mathematics. General mechanics. Technological mechanics. Mineralogy and knowledge of stones. Measuring. Theoretical chemistry. Chemical manipulations. History of literature.

The course of higher mathematics is compulsory only on those pupils who have the intention of subsequently following the special courses of the second and third year. This exemption might also, we think, be very properly accorded to the pupils destined to follow the chemical arts. It would seem that in many cases the higher mathematics and general mechanics might be advantageously replaced by a simpler instruction, though one quite as accurate.

After the first year's studies, the pupils of the A division (mechanicians) are advised to pass two years in a workshop as apprentices, if they have not done so before entering the institute. They ought afterwards to return to go through the studies of the second and third year; but in practice very few of them do so. Some of them have partly forgotten, others are content with what they learned during the first year; and this is an additional reason for regretting that the teaching of mathematics and mechanics is not more elementary during that year. It is, however, right to add that the pupils who have the resolution to return, after two years' practical occupation in workshops, evince great firmness of purpose and zeal in their professions; and, when thus prepared by theoretical and practical studies, they cannot fail to become distinguished engineers. The truth of this conclusion is abundantly proved by the success of the pupils of the Schools of Arts and Trades who complete their studies at the Central School in Paris.

During the month of September which precedes the resumption of studies after the vacation, the pupils of the A division (mechanicians) are expected to frequent workshops and to familiarize themselves with the working of steam engines and machinery; those of the B division (engineers) are engaged in topographical surveys and making of plans.

The subjects of instruction for the second year are distributed as follows:—

Division A.—*Mechanicians.*—Analytical mechanics. Resistance of materials. Hydraulics. Studies of machines. Project

of a machine. Technological mechanics, spinning, and weaving. History of literature.

Division B.—*Engineers of Roads.*—Analytical mechanics. Resistance of materials. Hydraulics. Roads, railways, hydraulic constructions. Project of a building. Mensuration. Topographical drawing. Physical geography. History of literature.

Division C.—*Chemists.*—Technical chemistry. Theoretical chemistry of elements. Chemical manipulations. Physical geography. Technological mechanics. History of literature.

Division D.—*Professors.*—Analytical mechanics. Resistance of hydraulic materials. Mensuration. Physical geography. Theoretical chemistry. Chemical manipulations. Experiments in physics. History of literature.

The courses of the third year are :—

Division A.—*Mechanicians.*—Higher mathematics. Study of machines. Projects of machines and factories. Theory of heat. Technological mechanics. Corn-mills, paper-mills, &c. Political economy. Elements of natural philosophy.

Division B.—*Engineers of Roads.* Higher mathematics. Theory of electricity. Construction of bridges. Projects for works of art. Mensuration. Road works. Political economy. Elements of natural philosophy.

Division C.—*Chemists.*—Technical chemistry. Elements of theoretical chemistry. Chemical manipulations. Technological mechanics. Political economy. Elements of natural philosophy.

Division D.—*Professors.*—Higher mathematics. Exercises in mathematics. Theory of heat. Theory of electricity. Chemical manipulations. Mensuration. Theoretical chemistry. Studies in practical chemistry. Political economy. Elements of natural philosophy.

After the vacation, in the month of *September* preceding the resumption of studies for the third year, the pupils of the A division (mechanicians) have to visit workshops, admission to which is procured for them, and the pupils of the B division (engineers) have to take plans.

It is a matter of regret that, during the vacation, the mechanicians are not obliged to take plans of manufacturing works, with sketches, drawings, and observations, like the pupils of the School of Metz and those of the French School of Mines. This is a most useful exercise, and a good preparation for the drawing up of projects.

Besides the compulsory courses for each special division there are others which are optional relative to legislation, heating apparatus, book-keeping, commercial arithmetic, the rules of exchange, stenography, and the French and English languages. The projects drawn up by the pupils for manufactures or constructions appertaining to bridges and roads are carefully studied, and all the principal parts drawn to scale. The chemical laboratory, though rather small, is well arranged to accommodate from 25 to 30 pupils. The collections of models are rich and numerous. Models of machines, bridges, carpenter's work, canal locks, looms,

and specimens of raw materials, of various products, of mineralogy, &c., are at the disposal of the professors for their lectures. The line drawings, simple and clear, are also very useful to the pupils. The principal periodicals treating of the sciences are placed for three months at the disposal of the professors, and are then deposited in the library, which contains from 8,000 to 10,000 volumes. The linear drawing, though correct, is wanting in neatness and purity of the lines; but the choice of subjects seems very judicious.

At the end of each half year for the general courses, and of each year for the special divisions, certificates are delivered to the pupils, showing the result of their marks and the merit of their works. Those who have completed the three years' studies of the Divisions A and B, may present themselves for examination, and if they pass satisfactorily they receive a certificate of maturity which qualifies them for the examinations for admission to the public services As regards the pupils of division D (teachers), the certificate of maturity exempts them from the examination for the mathematical sciences, for natural history, and even for Greek, required by the universities to be admitted as professors of mathematics.

At Easter 1863, there were at the Dresden Polytechnic Institute:

		Pupils.
At the general courses - - - -		- 97
At the special courses A, B, C, D	of the 1st year	- 47
	of the 2nd year	- 36
	of the 3rd year	- 29
At the modelling school annexed	- -	- 15
At the various optional courses	-	- 17
	Total -	241

Free auditors are also admitted to the separate courses. Pupils usually enter the Polytechnic Institute between 16 and 18 years of age. Saxon subjects pay a school fee of 40 thalers, and foreigners 60 thalers. The total budget of the institute amounts to 30,000 thalers, of which about 10,000 are derived from the fees, and the rest is supplied by the State. The conditions of admission to the general courses are a certificate of satisfaction delivered by a practical school, or on leaving the third class of the Chemnitz School. The institute has 23 professors, whose salaries range from 500 to 2,000 thalers, according to the importance of their courses and their length of service.

Annexed to the Dresden Polytechnic Institute, but established in a separate building, is a Modelling and Drawing School. It is placed under the direction of an artist who has resided several years in Paris, and follows the method of the late M. Dupuis. He begins by setting his pupils to draw simple blocks of wood, alone or grouped; next, geometrical solids, and plaster casts of relievos and statues; and lastly from nature; then his pupils proceed to make models in clay and plaster. The pupils of this school who have become adepts in modelling, easily find employment in iron or brass

foundries, or in supplying models for sculptors in wood and stone. Those who devote their attention to the invention of designs for textile fabrics are not so fortunate. This school has a very good collection of plaster models of all kinds.

Admission of Engineers to the Public Services in Saxony.

All engineers desirous of entering the public services must undergo an examination before a Royal Commission of ten members appointed by the Minister of the Interior and of Finance, and must produce certificates showing that they are proficient in all the matters taught in the upper courses of the Dresden Polytechnic School, that they know the French and English languages (or one of them at least), well enough to understand scientific works written in them. They must also prove that they have been practically engaged in the exercise of their profession for three years at least. The diplomas granted relate to four departments: 1. surveying; 2. bridges and roads; 3. machines; 4. architecture. The examination consists in the first place of a composition in drawing involving the application of all the sciences required for the particular department, and must be accompanied by an explanatory text, to show the candidate's command of the German language. If this first test of the candidate's abilities be passed satisfactorily, a *vivâ voce* examination follows, which consists in discussing his composition and replying to all objections made against it. He has also to answer questions on the branches of the public administration and on the decrees and laws concerning its organization. If the candidate is again successful, he is entitled to demand from the Ministry of the Interior and of Finance, a diploma conferring, according to the department he has chosen, the title of Surveyor of the 1st Class, or Engineer of Bridges and Roads, or Civil and Mechanical Engineer, or lastly, of Architect. The fee for the examination and the diploma is in all 10 thalers. The diploma thus obtained does not gives its holder any claim on the Government for actual employment, but merely proves his fitness for it, in case his services should be required.

General Summary of the Educational Establishments of Saxony.

The system, the principal elements of which have just been sketched, constitutes a complete system of studies in which every class of pupils can find the kind of education adapted for them.

For a population of 2,123,428 souls there are in all 2,016 primary schools, or one for every 1,053 inhabitants; 2,016 Sunday schools, to continue the work of the primary schools; schools for children employed in factories; six schools for master artisans; one school for builders; four schools for boatmen and pilots; industrial schools; apprenticeship schools for girls (weaving, embroidery, lace-making, &c.); gymnasia; practical schools; one polytechnic institute with its special school of drawing; the University of Leipsic.

It is easy to see that a country where a plan of education is thus organized so as to meet all the requirements of its intellectual and industrial activity, and which has a fertile soil containing great mineral wealth, cannot fail to possess all the elements of prosperity.

The kingdom of Saxony, owing to the fortunate conditions in which it is placed, being free from the necessity of maintaining a large army, and having enjoyed for 50 years past a profound peace, scarcely disturbed by the events of 1848, presents the somewhat unusual spectacle of a State which, without neglecting any of the modern improvements, is able to reduce taxation even while augmenting the salaries of its public functionaries. The total expenditure of the kingdom amounts to 10,500,000 thalers; of this sum the army takes 2,250,000 thalers, or 0·214 of the whole budget; and public instruction of all kinds 392,000 thalers, or 0·037 of the whole.

All the educational establishments and the expenditure consequent thereon are divided between the three following ministries :—

Ministry of Public Instruction.

Primary instruction	52,000	280,000 thalers.
Normal schools	58,000	
Deaf and dumb schools	30,000	
Gymnasia and practical schools	50,000	
Universities	90,000	

Ministry of the Interior.

Polytechnic institute	23,000	86,000 thalers.
School of arts and trades	14,000	
Special schools	28,000	
Fine arts	21,000	

Ministry of Finance.

School of mines	12,000	26,000 thalers.
School of forests	14,000	
Thalers		392,900

SPECIAL REPORT ON THE EDUCATIONAL ESTABLISHMENTS OF THE AUSTRIAN EMPIRE.

Education in the Austrian Empire is carried on in four principal classes of schools :—

1. The primary schools (*Volkschulen*), or lower and higher elementary schools, and the middle class schools (*Bürgerschulen*). To this group belong the infant schools, asylums for the deaf and dumb and for the blind, orphanages, and schools conducted by religious corporations, as well as the normal schools for teachers of both sexes.

2. The Middle or Secondary schools (*Mittelschulen*), for literary, scientific, and industrial education, such as the Gymnasia and the practical schools (*Real Schulen*).

3. The higher schools, and especially the universities and technical institutes. To the former are attached the theological and law schools, and the schools of surgery and obstetrics, where technical instruction is given.

4. The special schools :—for the military service ; for the naval service ; for industry, commerce, and navigation ; schools of agriculture, forests, and mines ; schools for instruction in the fine arts. The Oriental Academy is classed under this head.

Primary Schools.—These are generally intended for children from six to sixteen years of age ; they are classed as public and private schools. The former, founded and directed by the State, can grant certificates of studies ; the latter, can only be established with the permission of the Government in large towns, and must obtain a special permission to grant certificates.

The elementary or primary schools are subdivided into :—lower elementary schools, with three classes ; higher elementary schools, with four classes ; and middle class schools (*Bürgerschulen*), with six or seven classes.

The first give only that degree of instruction which, according to the Government regulations, every child ought to possess, viz. : religious instruction, reading, writing, arithmetic, singing, and for girls the kinds of work proper to their sex. In learning to read, the pupils are to be taught the more important facts of the natural sciences. As additions to the above, the children may be instructed, according to the locality, in pruning, managing bees, rearing silkworms, gardening, &c. The laws of the State render primary instruction compulsory. Primary schools must be established wherever needed. A very large portion of the empire is already well provided in this respect ; and in other parts, especially the east and south, they are to be founded in sufficient numbers so that the law on compulsory education may be strictly enforced.

The higher primary schools continue and complete the education received in the lower ; they teach a second language of the

empire, (in some places a third,) and drawing. They prepare pupils for the middle schools. As a general rule there are schools of this kind in every town of 3,000 inhabitants, but attendance is not everywhere enforced.

The middle class school (*Bürgerschule*) is composed of the primary school and of two, and frequently three, practical (*real*) classes in subjects the knowledge of which is necessary for the petty industries of towns and rural districts. The practical classes are organized like the lower classes of the practical schools (*Realschulen*), and to this extent resemble the middle schools, from which, however, they are distinguished because they give a less scientific instruction and have chiefly in view the most ordinary applications, as the majority of the pupils on leaving the middle class school enter upon practical life. It is for this reason that the Government allows the practical classes in the *Bürgerschulen* to be organized differently according to the requirements of local industries, and even to add several years of industrial instruction in a special direction. These middle class schools are found in most of the towns containing 6,000 or 7,000 inhabitants, but attendance is not compulsory.

High Schools.—Under the designation of *Hauptschulen* (high or principal schools) there are in Austria a number of institutions for continuing the education which both boys and girls have received at the primary schools. They are further instructed in religion, in the German language, reading, writing, and arithmetic, with some notions of history, geography, natural history, the elements of drawing and of singing. These schools have three classes, and suffice to prepare children for entering on the humbler employments in trade or for admission to the real schools.

The only special instruction given to girls consists in ordinary needlework. It is much to be desired that the schools of this kind, which, like the Evangelical School of Vienna, are annexed to the practical schools, should take greater advantage for girls, as they do for boys, of the means for industrial instruction possessed by those establishments.

Special Primary Schools.—This designation is given to schools established in factories, to institutes, and schools for the deaf and dumb and for the blind, also to the work schools for girls.

In all these schools religious instruction is given for each communion according to its rules. The mother tongue of the children is that in which the instruction is given; there are consequently 19 different idioms used for this purpose, as will be seen further on. The establishment of distinct schools for the sexes is the general rule, and it is observed whenever the local resources allow of it. The middle class schools are for boys only.

Primary Improvement Schools (*Werktags and Fortbildung Schulen*).

Every primary school is at the same time a week-day and a Sunday school for continuing the instruction. The week-day schools

(*Werktags schulen*) hold classes from four to five hours, and the Sunday schools from two to four hours.

According to the regulations, which render primary instruction compulsory, every child who does not receive at home, or in a private school, the instruction required, must attend the public primary school on week-days from six years of age till 12, and when, on leaving the primary school, he does not enter a higher school, he must, until 15 years of age, attend the Sunday school, the object of which is to improve and extend the instruction of boys and girls in the knowledge required for the business of practical life. The teaching is the continuation and the complement of that given in the week-day school. The primary and upper middle class schools have Sunday schools divided into several classes, according to the proficiency of the pupils. Instead of Sunday schools, in some localities, there are evening schools.

In these schools the professors are expected to give their teaching a demonstrative character, and are allowed every latitude within the limits of the programme adopted by the Government. All the reading and other books are chosen by the Government, and in the middle class schools alone are the professors allowed to introduce other works. The regulation books are printed at the expense of the Government, which supplies them at cost price. Nearly one fourth of the copies are distributed gratuitously to the children of poor parents.

Normal Training Schools (*Lehrerbildungs-Anstalten*).

Special establishments for training teachers of primary schools exist in all parts of the empire, for the different religious communions and the different languages. These institutions are in direct relation with the model schools. The duration of the studies is two years. Candidates must be at least 16 years of age, and must have followed a complete course of studies in a middle class school or a practical school for boys, or in a higher primary school (*höhere töchterschule*) for girls. There are also Government institutes (*Staats institut*) amply endowed, where a limited number of the daughters of functionaries and officers are educated, at the expense of the State, to become teachers in the upper classes of society. Paying pupils are likewise admitted; the pupils are received at eight years of age and stay till they are 20.

The courses for training teachers for the middle class schools occupy two years, but no pupils are admitted without first passing through a higher practical school. For the improvement of teachers already in practice, there are numerous libraries and conferences of masters established at the instance and under the direction of the district inspectors.

Position of Teachers.—In the country districts the schoolmaster generally holds some office connected with the Church. The masters of the lower primary schools have, on the average, a salary of

250 florins, besides lodgings and other emoluments, such as the use of a garden or field, contributions in kind, &c. In the higher primary and middle class schools the salary varies from 300 to 800 florins besides certain advantages of position. In addition, every schoolmaster has the right to give private lessons in his leisure hours.

All the schoolmasters hold their office, either directly from the Government or from municipal bodies under its sanction and supervision. Although they are not considered as Government functionaries, they enjoy some of the privileges attached to that quality, and hold a social position in keeping with the importance of their duties. They cannot be dismissed without the consent of the Government.

Expenses of the Schools.—The schools are supported by the Government and the townships. The State entirely maintains the normal schools for teachers. It also finds all the funds for several of the higher primary and middle class schools which are the centres of instruction in extensive districts, and likewise a number of institutions for the blind as well as the deaf and dumb. It makes grants for founding new primary schools when the localities cannot raise sufficient funds. The founding of primary schools is compulsory by law and they are regarded as local establishments; for all that concerns religion they depend on the religious communities.

One of the principal resources of the schools is the patronage, which in general falls to one of the large landowners, who usually exercises it in virtue of contracts and donations. These patronages are for the most part attached to lands belonging to the State, to private individuals, to religious endowments or to Church property. Lastly, the schools derive considerable sums from the fees paid by the children of well-to-do families. The poor pay nothing, and there are no schools especially for them. The fee varies, according to the class of the school and the proficiency of the pupil, from 1 to 4 florins a year, and even more.

Trade Schools (*Gewerbeschulen*) for Apprentices and Workmen.

The schools, which are known in Prussia and great part of Germany by the name of Improvement Schools (*Fortbildungschulen*) are in Austria called Trade Schools (*Gewerbeschulen*), or industrial schools. The confusion which these different significations of names may cause, ceases when we examine the object, the conditions, and the nature of the instruction given in these establishments. Their creation in Austria, and in Vienna especially, dates only from the year 1857, when the Industrial Society was formed, with the approbation of the Government and the assistance of the municipality.

The members of this society imposed on themselves, in principle, the obligation of sending their apprentices, during the last year at least of their time, to follow the classes, which, under the title of *Gewerbeschulen*, should be opened in the practical schools

of the State or those of the town, and also to pay a subscription in proportion to the importance of their establishments, even when they had no apprentices. This voluntary contribution is fixed at four kreutzers per florin (or one-fifteenth) of the taxes paid. On the other hand, it was decided that the apprentices should attend these classes during their last year, or in default should not be regarded as having finished their apprenticeship.

The teaching in each of these schools is under the supervision of the director, and is given by the professors of the practical school to which it is attached. The latter receive an addition to their salary in proportion to the number of hours' lessons; if one of the professors be unable to undertake this additional work, the director appoints another person in his stead.

In 1861, owing to the efforts made by the Chambers of Commerce and the manufacturers, there already existed in the suburbs of Vienna five of these schools annexed to the practical schools of Gumpendorf, Wieden, Landstrasse, Jägerzeile, and Schotenfeld, as well as a school of weaving (*Weberschule*) at Gumpendorf, and a practical school of building. They have the use of the premises, collections, and teaching appliances of the practical schools without any expense; but the models of a more technical kind required are purchased with their own funds.

The instruction is divided into an elementary section having two classes, and several sections relating to different industrial specialties. In the elementary section theoretical instruction is given and the pupils are practised in the art of drawing, with especial adaptation to the future career of each. In the special sections, the knowledge acquired is applied to the branches of industry chosen by the pupil. The organization of the specialties must be adapted, in every district, to the requirements of the local industries. The specialties of the Gumpendorf school are therefore principally those necessary for weavers, workers in silk, ribbons, trimmings, dyeing, &c. The school of Wieden has specialties connected with machinery, and such trades as brass-turners, joiners, bookbinders, workers in copper and bronze, founders, &c. In the Jægerzeile school the courses will bear chiefly on the building trades. The number of hours is nine and a half during the week, partly after half-past six in the evening, and partly on Sundays in the forenoon. No class must exceed 50 pupils; if there are more, it must be divided into two. In the first class of the elementary section the time allotted to the different lessons is as follows:—

	h.	m.
Religion	0	30
German language	2	0
Arithmetic	2	0
Caligraphy	1	0
Drawing	4	0
Total	9	30

The following is the allotment of time in the second class of the elementary section,—

	h.	m.
Religion	0	30
German, exercises in style and commercial correspondence	1	0
Arithmetic and mensuration	1	0
Elements of physics	2	0
Geography	1	0
Drawing, geometrical and free-hand, projections, drawing of figures and ornament, and modelling	4	0
Total	9	30

By this arrangement a single pupil attends, including the three kinds of drawing, 17½ hours instruction per week at most.

In the special sections the lessons are thus distributed:—

	hours.
Industrial drawing	4
Architectural drawing, estimates	4
Drawing of machines, mechanics, study of machines	4
Modelling, and drawing from the round	4
General chemistry	1
Study of raw materials	1
Commercial book-keeping, &c.	1
Applied mechanics	1
Applied chemistry	1
Total	21

In the two elementary sections, the instruction is compulsory for all the courses. In the special sections, on the contrary, the choice of courses is left to the pupils.

The school year commences on the 1st of October and ends on the 31st of July. At the end of the year the pupils receive certificates giving an account of their behaviour, application, and progress in the different branches. A pupil who is compelled by the force of circumstances to leave the school before the end of the year, may exceptionally, in certain cases, receive a certificate of attendance, and even be authorized to present himself at the examinations which close the year. The most proficient pupils receive as prizes silver or bronze medals, or honourable mentions.

The director of the practical school, to which the school for

apprentices is annexed, is the principal manager. He, however, shares this authority with a delegate of the Industrial Society. They both endeavour to introduce into the teaching all the improvements required by the necessities of the local industries as indicated by the presidents of the industrial associations which patronize the schools. The instruction, as already stated, is given by the professors of the corresponding courses of the practical school (*Realschule*), provided that the professors have sufficient time at their disposal and are satisfied with the payment offered. When any professor declines to undertake a course in the apprentice school, the director has to look for a teacher elsewhere. For the technical instruction, the director may, with the authorization of the municipal authority, admit as professors either manufacturers or foremen, who, in everything connected with the teaching, will be under his orders. For the purchase of apparatus and all things necessary for consumption and use, there is a yearly budget placed at the disposal of the director in concert with the professor of the specialty concerned. A further account of this arrangement is given hereafter.

The general management of the trade schools of Vienna is entrusted to a council composed of the presidents and vice-presidents of the chambers of commerce and manufactures, of the representatives of the province and city of Vienna, of the president of the committee of each school, and, lastly, of members of the chambers of commerce elected for the purpose. This council meets on certain days in general assembly, to ascertain, in the presence of the directors, the state of the schools and to deliberate on the means of extending their usefulness.

Every member of the Industrial Society for promoting the establishment of schools, whether he have apprentices or not, is bound to pay a contribution calculated on such a basis that the total, with the addition of sundry subventions, will cover the whole probable expenses of the school during the current year. By so doing, he has the right to send his apprentices (if they have received the proper elementary instruction) to the school, without any further payment, except for writing and drawing materials. Apprentices after becoming journeymen cannot continue to attend the school without payment of the regular fees.

Trade School for the Improvement of Apprentices and Workmen at Prague.

Thirty years have elapsed since the Industrial Society of Bohemia (*Gewerbs Verein von Böhmen*) founded a school of drawing and modelling in plaster, rightly thinking that the art of drawing can best instruct workmen, and impart to them an abundant store of useful and scientific knowledge with which no other means could so easily familiarize them. At a later period this society was anxious to give greater extension to its scientific instruction, but was long unable from want of funds, and has only lately succeeded in carrying out its projects. An eminent

engineer, who had carefully studied the organization of industrial education in France and other countries, was engaged to draw up a plan of studies for the school intended for workmen. This plan, published under the title of *Draught of Statutes for the Manufacturers' and Tradesmen's School of Prague*, was submitted to the Diet of Bohemia and to the council of the town, and was adopted by them. The town provided a building for the establishment, as well as the furniture, and a yearly grant of 1,500 florins, the Diet voted 2,000 florins, and the Industrial Society engaged to give another 2,000 florins. The school, therefore, has a fixed income of 5,500 florins. The immediate superintendence of the school is entrusted to a council of three members elected by the Diet, three members of the municipal council, and three members of the Industrial Society.

The school was opened in 1863. The pupils are taught through the medium of both the German and the Bohemian languages, which in some cases renders two professors necessary for the subjects. The professors, who are nearly all attached to the professorial staffs of the two higher practical schools of the town, are 16 in number.

The plan of studies for the year 1863–64 is as follows :—

Sunday.	From 8 to 9 a.m.	Technology.
	From 8 to 10 p.m.	Practical weaving.
	From 10 to 12 a.m.	Exercises in linear drawing. Exercises in free-hand drawing. Drawing of machines. Free-hand drawing of ornament.
	From 2 to 4 p.m.	Exercises in linear drawing. Exercises in free-hand drawing. Drawings for construction of buildings. Free-hand drawing of ornament.
Monday evening.	One hour	Lectures on machines. Chemistry.
	Two hours	Natural history. Algebra and geometry.
	Two hours	Drawing for construction of buildings. Modelling.
Tuesday evening.	One hour	Arithmetic. Art of construction.
	Two hours	Written compositions and style. Chemistry.
	Two hours.	Drawing of machines. Modelling. Drawing of patterns.
Wednesday evening.	One hour	Algebra and geometry.
	Two hours	Lectures on machines. Art of construction. Lessons in ornamentation.
	Two hours	Drawing of patterns.

Friday evening.	One hour - -	Physics and mechanics. Technology.
	Two hours - -	Lectures on machines. Art of construction. Modelling.
Saturday evening.	One hour -	Geography. Natural history. Lectures on machines.
	Two hours - -	Arithmetic. Book-keeping. Physics and mechanics.
	Two hours -	Modelling.

These lessons are given in the different class-rooms of the practical school of Prague.

In winter evening classes are held from half-past six to half-past eight, and in summer from seven to nine o'clock. The lectures and drawing relating to the building arts end at Easter, those for other industries last from the beginning of October to the end of July. Candidates for admission to the preparatory school must be able to read, write, and calculate; and to attend the courses of the special divisions they must produce a certificate of capacity from the preparatory school, or from a lower real school. The fee is half a florin a year for each course attended; it is paid half-yearly, and in advance.

The technical and practical teaching is distributed into five principal divisions, according to the branches of industry in which the pupils are engaged.

The first is the school for the building trades, for masons, stone-cutters, carpenters, joiners, &c.; the instruction includes geometry, the elements of algebra, the art of building in general, drawing for building and modelling, notions of physics and mechanics, the effects of heat; these studies require two winter half-years. The second is the school for the construction of machines; for smiths, mechanicians, conductors of machines, coppersmiths, modellers, joiners, &c.; they are taught geometry, the rudiments of algebra, the elements of physics and mechanics, the description and study of machines, and also drawing; these studies require two years. The third, or chemical school, is for dyers, brewers, tanners, soapboilers, &c.; the lectures treat of general chemistry and chemical technology. The fourth is the school for weaving and spinning; here the pupils are taught practical weaving, the calculations relative thereto, the preparations of the cards, taking out of patterns, &c. The fifth, or school of industrial art, is intended for manufacturers of porcelain and earthenware, glass blowers, goldsmiths, confectioners, &c.; the instruction consists of drawing and modelling.

At the close of the courses there are examinations, after which certificates of capacity are given to the deserving, and the two pupils at the head of each division receive prizes. The number of workmen who attended the Prague school in 1863–64 was 762, of whom from 15 to 20 per cent. were Germans, and the rest Bohemians.

LIBRARY OF THE UNIVERSITY OF MICHIGAN

The expenses of the school amount yearly to the following sums:—

	Florins.
Salaries of professors	2,380
Teaching of drawing and modelling	1,620
Collections	700
Direction and service	520
Warming	280
Lighting	400
Total	5,900

Of this total the fees paid by workmen produced only 1,000 florins, about one-sixth of the cost. The rest was covered by donations and subscriptions. Drawing is taught, as in the practical schools of the same town, by means of models in relief, almost precisely the same as by the Dupuis method.

Besides these trade schools established in the cities of Vienna and Prague, there are others of the same kind in many towns of the empire. Sunday and evening schools have been founded in most of the towns and manufacturing districts by the efforts of the local authorities, of the chambers of commerce, industrial societies, and private individuals. Numerous apprentice schools, properly so called, have been established; as for example at Brünn for weaving, and at Prague by a central committee for the benefit of the poorer inhabitants of the Erzgebirge. In these schools lace making, sewing, knitting, straw-plaiting, &c. are taught. In 1859 there were already 70 such schools receiving 11,000 pupils.

Upper Schools of Industry and Commerce.

The Trieste Commercial and Nautical Academy is composed of two divisions, one for commerce and the other for navigation. The number of professors is 23, and of pupils 150. There are also five nautical schools, dependent on the Trieste Nautical Academy, at Venice, Fiume, Spoleto, Lussin-Piccolo, and Cattaro. They have seven professors, and only 100 pupils.

Under the same head we must place the superior academy of commerce at Prague, founded in 1826. It has three classes. The condition of admission is a satisfactory certificate of studies from a practical school or a lower gymnasium. In 1827 was founded the Academy of Commerce at Vienna, which will be separately described, as well as the superior society of commerce at Pesth. In 1859, this last had 29 professors and 136 pupils. All these establishments are private, and were founded by companies.

Special Schools of Agriculture.

These schools are divided into two classes, a higher and a lower.

A superior school or academy for the complete study of agricultural science exists at Attenburg in Hungary. It has nine

professors and 147 pupils. The school fee is 63 florins; the total yearly cost 19,400 florins. It is a Government establishment, possessing collections of all kinds, a chemical laboratory, a technological gallery, a library, and a botanical garden. It gives instruction in arboriculture and in rural and forest management.

Middle agricultural schools have been founded at Grossau, in Lower Austria; at Teschen-Liebwerd, in Bohemia; at Kreutz, in Croatia, and at Dublany, in Gallicia. The studies occupy two years. There are 27 professors, and 164 outdoor pupils. The school fee is from 30 to 52 florins. The yearly expenditure amounts to 9,200 florins. They are maintained by local resources and agricultural societies.

There are seven lower agricultural schools: at Grossau, in Lower Austria; at Liebejei-Rabin; at Teschen-Liebwerd, *in Bohemia*; at Gratz, in Styria; at Kreutz, in Gallicia; at Ezernichow, in Gallicia; and at Laybach, in Carinthia. These schools have 23 professors and 230 pupils. The school fee varies from 30 to 40 florins, partly recovered by the work of the pupils. There are 72 gratuitous pupils.

Forest Schools.

Superior forest academies are established at Mariabrunn *in* Lower Austria, and at Schemnitz in Hungary. The studies extend over from two to three years. The qualification for admission is a certificate of studies from a gymnasium *or a* superior practical school. These establishments have a museum, collections, a botanical garden, and a laboratory. They have 14 professors and 160 pupils in the two together. The school fee is 10 florins. There are some gratuitous pupils. *Both schools* are maintained by the Government.

The middle forest schools are situated at *Wiesswasser, in* Bohemia; at Aussen in Moravia; at Kreutz, in Croatia. The studies occupy from two to three years. The primary school is the only preparation required. These schools *have 12 professors* and 100 pupils. The gratuitous admission *is compensated* by the work of the pupils.

At Pibram, in Bohemia; at Windschacht, in Hungary; and at Nagnay, in Transylvania, there are Lower Forest Schools. The courses extend over two or three years. The preparation required is the primary school and the habit of working. There are eight professors and 87 pupils, all gratuitous. These establishments are maintained by the State.

Schools of Mines.

Mining academies exist at Schemnitz, in Hungary; at Leoben, in Styria; and at Pibram, in Croatia. The courses last from two to four years. The qualification for admission is a certificate from a gymnasium or a higher practical school. There are 23 professors and 255 pupils. The school fee is 10 florins, and

many pupils are admitted without payment. The total expense is 14,700 florins. These establishments are supported by the State.

The Oriental Academy.

This school has for its object the teaching of the languages and political law of the East; it has 21 out-door pupils and six professors, and is maintained by the State.

Schools of Art and Music.

The Schools of Art in Austria are:—The Academy of the Plastic Arts, at Vienna, supported by the State, and founded in 1704; it now has 11 professors and 200 pupils. The Academy of painting at Gratz, maintained by the province, with from 30 to 50 pupils. The Academy of Arts, at Prague, supported by the Patriotic Society of the Friends of Art; 61 pupils. The School of Fine Arts, at Cracow, at the Technical Institute; five professors and 24 pupils. The Academy of Fine Arts at Venice, founded in 1670; nine professors and 340 pupils. The Academy of Painting and Plastic Art at Verona; 30 pupils.

Besides these there are the Conservatories of Music at Vienna and Prague, and since 1858, 52 other schools of art and music, partly organized by associations, partly by professors, and having in all 231 professors, and 3,973 pupils of both sexes.

The Vienna Conservatory of Music is a private foundation, but receives from the Government a considerable yearly grant. The studies extend over six years, and the fee is 4 to 6 florins per month. There is a public concert twice a year. This establishment has one director, 20 professors, and 209 pupils of both sexes.

At Prague the Conservatory of Music was founded and supported by the Society for the Improvement of Music; it is divided into a school for instrumental music, another for singing, and a third for the stage. The studies last six years in the first school, two years in the second, and two or three in the third (opera). For natives the teaching is gratuitous. There are a director, a sub-director, and 19 professors.

Academy of Commerce (*Handel's Akademie*).

Under the title of Academy of Commerce there was founded at Vienna, in 1857, a very remarkable establishment for the instruction of young men intending to follow commercial pursuits. A capital of 400,000 florins was subscribed, and suitable premises built for the purpose. The school is provided with technological collections, a museum of natural productions, and complete chemical laboratories. A committee composed of nine members presides over the general management. The instruction is given in two divisions, one of them preparatory, requiring two years' study, the other technical, occupying the same length of time.

The number of hours per week devoted to the different branches of instruction is shown in the following table.

Preparatory Division.				Technical Division.			
Subjects taught.	Number of hours.		Totals	Subjects taught.	Number of hours.		Totals
	1st year.	2nd year.			1st year.	2nd year.	
Religion	2	2	4	Commercial calculations	3	3	6
German	4	3	7	Book-keeping	2	–	2
Arithmetic	5	4	9	Commercial correspondence.	3	–	3
Geography	4	3	7	Political economy	3	3	6
History	3	3	6	Commercial law and exchanges.	–	–	–
Natural history	4	2	6	Geography, commercial and statistical.	2	2	4
Caligraphy	2	4	6	Commercial history	3	2	5
Book-keeping	–	2	2	Chemistry	3	2	5
Physics	–	2	2	Physics	2	–	2
				Study of merchandise and technology.	3	4	7
				Austrian commerce and manufactures.	–	–	–
				Model counting-house	–	3	3
Totals	24	25	—	Totals	24	24	—

Besides this compulsory curriculum there are French, English, and Italian classes, one or other of which every pupil must attend, or two, or all, if he pleases. There are excellent laboratories for those pupils who wish to learn how to analyse different *kinds* of merchandise. This study is altogether optional. In winter qualitative analysis is taught, and quantitative in summer. The school fee is 157 florins. 50 kr. a year for all the courses.

At the close of the courses there are examinations for those who please to present themselves, and certificates of capacity are given to all who pass satisfactorily. Among the optional *branches* of instruction are stenography, to which some importance is attached, and drawing, which is cultivated both artistically and commercially.

Besides the regular classes during the day, there are evening classes for persons already engaged in business. These are held from 7 to 9 o'clock from October till Easter, and are attended by about 250 persons who pay four florins for each course, with the exception of the living languages, which are only two florins, and stenography, fixed at one florin. The subjects taught in these classes are commercial arithmetic, book-keeping, commercial correspondence, the rules of commerce, and exchange, &c., the living languages and stenography. The majority of the persons attending the evening classes present themselves for examination to obtain certificates. In this department discipline is maintained by the professors under rather severe regulations.

Middle Schools (*Mittel Schulen*).—Gymnasia.

The general and special object of the gymnasia is instruction in the dead languages, and preparation for the studies of the university.

Until the year 1849, there existed in the Germano-Slave countries of the Austrian empire, and in the Lombardo-Venetian kingdom (from which part of Lombardy was separated in 1859), including military schools, 92 gymnasia having six classes, and six gymnasia with four classes. The number of professors was 646 and of pupils 20,316. In 490 of these establishments, with 249 professors and 4,800 pupils, a two years' course of philosophy was insisted on. In other countries of the empire, gymnasia had been organized, but somewhat less completely in Hungary, Croatia, Slavonia, and Transylvania. There then existed 120 gymnasia, with 671 professors and 22,837 pupils, among which were 61 gymnasia having courses of philosophy with 200 professors and 2,500 pupils.

The decree of organization of 1849 raised the gymnasia from six classes to eight, by adding two classes of elementary philosophy, and gave greater extension to the teaching of Greek and the higher German literature; the teaching of history, mathematics, physics, and natural history was distributed over all the studies. At this period the use of the different native idioms was adopted for teaching, the study of philosophy, properly so called, was rejected in the universities, and great improvements were introduced in the mode of teaching.

A complete gymnasium is at present composed of a higher gymnasium and a lower having four classes. The lower gymnasium prepares pupils for the superior establishments, such as a higher gymnasium and the practical school. The higher gymnasium imparts a more complete scientific instruction, and is the proper preparatory school for the studies of the university. There are both public and private gymnasia. The first alone can give certificates of maturity.

In 1859 there were, in the whole empire, 240 gymnasia, 164 of them with eight classes, and 73 with four only; the number of titular professors was 2,454, of deputy professors 493, and of pupils 51,121. The regulations prescribe, that whenever the number of pupils in a class exceeds 50, it must be divided into two. A complete gymnasium has 13 titular professors, one of whom acts as director. An inferior gymnasium has only six professors. The professors are appointed after an examination before a commission of the university.

For each subdivision there is a principal or titular professor who takes precedence of other professors of the same class. The meeting of titular professors, with the director as president, forms the conference of professors. The immediate superior inspection is entrusted to a member of the Council of Instruction acting as inspector of gymnasia. The choice of the language in which the instruction shall be given depends, in general, on the place where the gymnasium is situated and on the country from which professors have to be procured. That language, however, is always chosen which appears most advantageous to the rapid progress of the pupils.

The compulsory studies are: religion, Latin, German, a second language spoken in the country, history, geography, through

eight classes; Greek from the third to the eighth class, natural history in the first, second, fifth, and sixth; physics in the *third*, fourth, seventh, and eighth; the elements of philosophy in the seventh and eighth. The other studies, such as the living languages, caligraphy, drawing, and gymnastics, are all optional. The number of hours of compulsory attendance in class varies from 22 to 27 per week. Sunday and two half days during the week are left free from compulsory lessons.

There are no regular examinations at the end of the year. Passing to an upper class is allowed or refused according to the pupil's progress, and there is no examination except in doubtful cases. To enter a university a pupil must have obtained a certificate of maturity on leaving the gymnasium, and the examination for that purpose is held under the direction of the inspector of the gymnasium. Pupils who have been educated at *home may* present themselves at these examinations on condition of regularly passing the half-yearly examinations.

The superior authority for instruction does not enforce the use of any particular books, but merely indicates those which may be used, and there may be different ones in the same class.

The annual payment in the gymnasia aided by the State varies from 8 fl. 4 kr. to 12 fl. 6 kr. Good conduct and rapid progress may exempt poor pupils from all payment. Besides *these fees*, pupils have to pay 2 fl. on admission to purchase school necessaries, and also examination fees to remunerate the examiners. The amount received in fees for all the Austrian gymnasia was, in 1859, 2,741,372 fl. There are a great number of exhibitions founded by the State or by private individuals, which enable clever young men of narrow means to pursue their studies. In 1859, 2,831 young men enjoyed these exhibitions, the whole of which amounted to the sum of 207,098 fl., which shows that the number of these exhibitioners was in the ratio of *435* to *603*.

Until 1849 most of the gymnasia were ill-supplied with the necessary appliances for teaching; but since then, owing to the active co-operation of the State, townships, and private individuals, their number has so far increased that, in some gymnasia, the library contains thousands of volumes, the cabinets of natural philosophy number 1,000 pieces of apparatus, and some collections as many as 2,000 articles.

The total expense of a gymnasium is 12,000 fl. The salaries of the professors vary from 735 to 1,050 fl. That of the directors from 1,150 to 1,365 fl. After each period of 10 years' service all professors receive an addition of 105 fl. to their salary, *and if* after 30 years' service a professor be unable to continue his functions, he is allowed to retire on his full salary.

Practical Schools (*Real Schulen*).

Until the year 1850 the practical schools (then only five in number) were in direct relations with the technical institutes, serving as preparatory schools for them. The instruction consisted especially in the elements of arithmetic and mathematics,

while the classical studies received little attention. The pupils were admitted on leaving the fourth class of the higher primary schools. The studies of these practical schools then occupied two years.

The reorganization of these schools was effected by a decree of 2nd March 1851, which laid down the principles for the organization of technical instruction and for the establishment of the practical schools. They were then all organized as distinct institutions under a separate management, and divided into lower practical schools with a three years' course, and higher practical schools with a six years' course.

The object of these schools now is to give the pupils, besides a general education,—not including the study of the dead languages,—a middle degree of instruction for the industrial professions, and sufficiently advanced to prepare them for the schools of technical instruction. The lower schools, as well as the first three years' classes of the higher schools, impart a degree of instruction sufficient for the generality of industrial professions, and also prepare for the three following years' studies of a higher practical school. The studies of the pupils in the first three classes, which constitute the lower school, enable the pupils who have made good use of their time to enter on the practice of the industrial arts with a very satisfactory education, as will be seen by the following details.

Drawing is taught in the earliest classes from models in relief, and no copying is allowed except for the purpose of teaching pupils to handle the pencil at the very outset. In the first year the pupils of the first class, eleven years of age, practise free-hand and elementary geometrical drawing, and make sketches of solid bodies and of geometrical forms, after models like those used in the Dupuis method. The use of rule and compasses is not permitted. They thus continue free-hand drawing of ornaments from casts, make copies of heads, and finish by drawing from the round. In the third class, which contains pupils from 13 to 15 years of age, drawing receives considerable extension, especially with regard to its application to the practice of the trades the pupils intend to follow. With this view special care is taken to make each pupil execute the designs which are most likely to be useful to him. For teaching descriptive geometry much use is made of rectangular planes and pins, which render sensible to the eye all the rules of the projections. This, in fact, is the mode of teaching which has been proposed and employed by M. Olivier, Professor at the Conservatory of Arts and Trades. His apparatus consists of two wooden planes articulated with hinges and covered with cork, in which the pins are stuck to represent the lines of projection.

The choice and number of the subjects treated in the three years' studies are such that the young men who intend to follow the practical industries of constructing buildings or machines may obtain in the lower practical schools sufficient instruction to become master-builders capable of understanding the plans to be

executed, and of representing their own ideas in drawings. These lower schools are therefore well adapted for giving the pupils the theoretical instruction calculated to make them clever master workmen, foremen, and conductors of works, when they shall have acquired the practical part of their trades in workshops and building yards. The pupils who wish to continue their studies pass on to the fourth, fifth, and sixth classes, in which the teaching of drawing is at once theoretical and practical.

The compulsory studies of the lower schools comprise religion, languages, history, geography, arithmetic, natural history, the elements of physics and chemistry, drawing, and caligraphy. The study of the second language of the country is compulsory only when it is the pupil's mother tongue, since at Vienna, German is the medium of instruction. Singing, gymnastics, and stenography are not compulsory.

The methods of teaching are for the most part simple and popular. In the three higher classes a more scientific method is followed, so as to give a general idea of human knowledge as well as a preparation for technical studies. Elementary mathematics are added to the studies of the lower schools. Instead of arithmetic, the study of machines becomes compulsory; caligraphy ceases to be so; and the living languages, French, Italian, and English, are taught without being compulsory.

The number of independent practical schools organized in conformity with the regulations was 52 in 1859, with 520 professors and 9,939 pupils. The number of hours' attendance for the compulsory courses ranges from 30 to 34.

The organization of these schools is, as far as teaching and discipline are concerned, exactly the same as that of the gymnasia. The number of professors is 12 for a higher practical school and six or seven for a lower. The number of pupils in one class must never exceed 80, and for drawing, when there are above 50 pupils, the professor has an assistant.

Every candidate for a professorship must first pass an examination before a committee established at Vienna, to show that he has the requisite scientific knowledge and a good method of teaching. He must next undergo a year's probation in a public practical school. Professors have the right to choose their text-books from among those authorized for use by the superior authorities.

The yearly fee for the practical schools varies according to localities from 8 to 20 florins. The cases of exemption from payment are the same as in the gymnasia. The entrance fee is 2·1 florins. It is intended to cover the expense of purchasing school necessaries. The salaries of professors are 630, 840, 1,050, and 1,260 florins, with an increase of 210 florins every 10 years. The supplementary functions of director are remunerated with 210 to 315 florins. The yearly expenditure for a lower school is from 8,000 to 11,100 florins, and of higher schools from 15,000 to 20,000 florins. The expenses of the royal and imperial schools are borne by the respective kingdoms: for the local schools by

the town revenues, and for the private establishments by particular endowments. Many practical schools are supported partly by the towns and partly by the State. The amount of the fees then belongs to the funds from which the grants are made.

The director and the council of professors have the entire management of the school. All these schools are under the immediate supervision of the government authority of the country, represented by a councillor of schools.

Higher Practical School at Prague.

This school, the origin of which the Bohemians trace with justifiable pride through the successive transformations, which the progress of industry rendered necessary, to the year 1576, in the reign of Rudolph II., an epoch long anterior to the foundation of most of the schools now existing in Germany, follows the same programme of studies as the Vienna schools, as will be seen from the following table. The pupils are divided into six classes, requiring six years' studies. The programme contains the following subjects of instruction, to which the number of hours indicated is devoted :—

—	1st Class.	2nd Class.	3rd Class.	4th Class.	5th Class.	6th Class.	Totals.
Religious instruction	2	2	2	2	2	2	12
German language	4	4	4	3–5	4	4	23–25
Geography and history	3	3	3	3–5	4	4	18–20
Arithmetic	4	4	3	–	–	–	11
Natural history	2	2	–	2	2	2	10
Useful knowledge	2	3	–	–	–	–	5
Bohemian language	3	3	3	3	3	3	18
Caligraphy	2	2	2	2	–	–	8
Freehand drawing	–	6	7	6	6	6	31
Chemistry	–	–	6	2	2	2	12
Construction of buildings	–	–	2	–	–	–	2
Mathematics	–	–	–	3	5	2	15
Linear drawing	–	–	–	–	4	4	8
Physics	–	–	–	–	4	4	8
Description of machines	–	–	–	–	–	2	2
Drawing of machines	–	–	–	–	–	2	2
Modelling	–	–	–	–	–	4	4
Geometry and construction drawing.	10	4	–	–	–	–	14
Italian	Out of class					2	–
French						2	–
Stenography						2	–

The distribution of the time shows how much attention is paid to instruction in religion, as well as in the vernacular languages—German and Bohemian—and in freehand drawing. Six hours per week at least are devoted, during five years, to this kind of drawing, and from two to four hours only for three years to linear drawing. The proficiency of the pupils is consequently

very remarkable, and superior to anything we have seen elsewhere. The modelling practised in the sixth year also appears very successful. The Dupuis method is strictly followed, and the school is supplied with all his models.

Out of 513 pupils 473 were Bohemians, 435 Catholics, 7 Protestants, and 71 Jews. The library contains nearly 1,500 volumes. The yearly school fee is calculated at the rate of half a florin per hour's lesson per week. A year's course of 30 lessons per week therefore costs 15 florins a year.

/ Of all the practical schools in Germany that of Prague is certainly the one where linear drawing is best taught, and we are inclined to attribute this fact to the attention given from the very outset to the practice of freehand drawing, which early habituates the pupil to trace his lines with a light hand.)

The instruction is given in German and Bohemian, but the professors are free to choose which language they please. There are in some cases professors of each language for the same course. The class-rooms, amphitheatres, and laboratories are spacious and well arranged. The collections are well stocked with models. The workshop for modelling will accommodate 25 pupils at once, and is well attended.

Practical School of Trübau.

At this school the experiment has been tried of uniting the pupils of a gymnasium with those of a practical school for certain classes under the teaching of the same professors. The starting point, and especially the object of the pupils not being the same, and the professors of the gymnasium being little acquainted with technological details, the instruction was not sufficiently scientific. It was too low for the pupils of the gymnasium and too high for those of the practical school. It was, therefore, found necessary to abandon this system, which, in France, would probably produce still less favourable results.

Imperial and Royal Higher Practical School at Vienna.

In this city there are two higher practical schools, one of them imperial and royal, belonging to the State ; the other municipal, founded by the city. Both have six classes, requiring at least six years' study.

The first is situated in the Landstrasse, in a building rented for the purpose, formerly the residence of Prince Lichtenstein. It has numerous collections, especially of mineralogy and natural history. Well arranged laboratories have been fitted up to enable the pupils who are so disposed to make themselves acquainted with the elements of chemical manipulation. There is a workshop for modelling, and the pupils are exercised in that art from a drawing, and conversely in drawing from models. The drawing-class rooms are very spacious and well lighted; the pupils have plenty of room. For drawing from the round or from models in relief, even elementary, there are cabinets or cells lined with

green cloth, and in which the models are lighted by a single gas burner, so that the shadows may be more distinct. The time devoted to lessons and graphic exercises, under the eye of the professors, is distributed as shown in the following table :—

——	1st Class.	2nd Class.	3rd Class.	4th Class.	5th Class.	6th Class.	Totals.
Compulsory.							
Religion - -	2	2	2	2	2	2	12
Arithmetic - -	4	4	3	–	–	–	11
Mathematics - -	–	–	–	9	5	2	16
German - -	5	5	4	5	3	4	26
Geography and history -	3	3	3	4	4	4	21
Natural history - -	2	2	–	2	2	–	8
Physics - -	2	4	–	–	4	4	14
Chemistry - -	–	–	6	2	2	2	12
Writing or caligraphy -	2	2	2	2	–	–	8
Freehand drawing -	10	6	7	4	6	6	39
Descriptive geometry, drawing.	–	–	–	–	4	–	4
Linear drawing of buildings.	–	4	3	2	–	–	9
Machine drawing -	–	–	–	–	–	4	4
Lectures on machines -	–	–	–	–	–	2	2
Modelling - -	–	–	–	4	4	4	12

Optional.

English language - - - -	5	hours	per	week.
Italian language - - - - -	3	„	„	
French language - - - - -	3	„	„	
Stenography - - - - -	2	„	„	
Singing - - - - - -	2	„	„	
Gymnastics - - - - -	2	„	„	

We see by this table the immense importance attached to the teaching of free-hand drawing, almost exclusively executed from models in relief. For the six classes it occupies 39 hours per week, whilst to linear drawing with rule and compass only 17 hours are given. Notwithstanding the great attention paid to freehand drawing, in which the pupils are very proficient, the linear drawing is not so fine and light as might be desired.

At the close of every year there is an examination, and marks are given ; according to the results the pupils pass to the upper classes. According to the information and notes of each professor the pupils are classed, and any note stating deficiency in a single branch of instruction prevents the pupil from entering the upper class, and, on leaving, deprives him of the certificate of satisfaction required for admission to the technical institutes. It is evident by these rules that the system of outdoor pupils is compatible with strict discipline. When a pupil leaves the sixth class of a higher practical school with a certificate of eminence he is admitted *de jure* into the first class of the Polytechnic Institute,

otherwise he must go through a year's preparatory studies. The examinations are very strict. The school fee at Vienna is *18 to* 20 florins a year. The pupils who perform chemical manipulations in the laboratory pay an additional entrance fee of two florins and one florin per month. The re-agents are furnished by the State.

Municipal Higher Practical School in the Suburb of Wieden, Vienna.

This school, founded by the city and administered by the municipal authorities, is of the same order as the Government *School*. The building is a very handsome one, and is most conveniently arranged. The class-rooms for drawing and study, and the laboratories are large and well lighted, and there are very good *collections* of apparatus and models. Drawing is taught from *objects* and models in relief. Freehand drawing receives far greater attention than linear drawing; the former has 38 hours weekly in the different classes, the latter only eight, and yet the results are satisfactory.

The subjects of instruction are distributed as follows:—

——	1st Class.	2nd Class.	3rd Class.	4th Class.	5th Class.	6th Class.	Total.
Religion	2	2	2	2	2	2	12
Arithmetic	4	4	4	—	—	—	12
Mathematics	—	2	—	9	5	2	18
German	5	5	4	5	3	4	26
Geography and history	3	3	3	4	4	4	21
Natural history	2	2	—	2	2	2	10
Physics	2	3	—	—	4	4	13
Chemistry	—	—	6	2	2	2	12
Writing and calligraphy	2	2	2	2	—	—	8
Descriptive geometry	—	—	—	2	4	—	6
Free-hand drawing	10	6	6	4	6	6	38
Linear drawing of buildings and machines.	—	2	2	—	—	4	8
Lectures on machines	—	—	—	—	—	2	2
Construction of buildings	—	—	2	—	—	—	2
Total	30	31	31	32	32	32	

We see by this table that the distribution of time and lessons is almost identical with that adopted at the Imperial and Royal School in the Landstrasse. It is the same with regard to the selection of the subjects for drawing, which, after relating to questions of general education, are divided into distinct industrial specialties.

The pupils who wish to manipulate in the laboratory pay one florin per month for two sittings of three hours each per week, during the vacations. The mineralogical and technological collections are remarkably well kept, and well provided with useful

materials. At the end of the courses every year, the pupils receive a report from each professor, and those whose reports bear the words *Insufficient instruction* for any branch of study are not allowed to advance into the next class. These reports are rigorously strict and the school bears the reputation of being very severe. A great many pupils of the sixth class or year go to the Polytechnic Institute or to the Military School of Artillery and Engineers.

Municipal Practical School of the Second Order in the Suburb of Gumpendorf, Vienna.

This school of the second order had, in 1862, about 180 pupils in its three classes. The instruction is regulated the same as the corresponding lower classes of the higher practical schools, and the severity of the examinations on passing from one class to another and on leaving is at least as great.

Protestant Lower Practical School, Vienna.

Besides the practical schools, royal and imperial and municipal, there are also others of a private character authorized by the Government. Of this number is the Protestant Practical School, of an inferior order, having only three classes, to which are annexed two primary schools, one for boys the other for girls. This school built by subscription on ground given by the city, cost 240,000 florins for first establishment; its yearly budget is 30,000 florins. It has a library of 15,000 volumes for the use of the professors.

The studies are arranged as in the following table :—

——	1st Class.	2d Class.	3d Class.	Total.
Religion	2	2	2	6
Arithmetic	3	3	3	9
German	5	4	4	13
Geography and history	3	2	3	8
Natural history	2	2	—	4
Physics	2	3	—	5
Writing and caligraphy	2	2	2	6
Free-hand drawing	2	4	4	10
Linear drawing	2	1	1	4
Geometry	2	2	—	4
Singing	1	1	1	3
Chemistry	—	—	6	6
Total	26	26	26	

The above statement shows that the instruction given in this school differs little from that in the preceding, and that the study of the German language and of free-hand drawing occupy the most time.

The pupils of this school pay an entrance fee of 5 florins and 12 florins a year. This remuneration, which is not paid by all the pupils, produces only 6,000 florins. The city gives assistance to the extent of 7,000 florins; the balance of the expenditure is covered by subscriptions. The direction of the establishment is almost entirely independent of State control. It is conducted under the supervision of a council elected by the members of the Protestant communion, and by a director also elected, but whose nomination must be approved by the Government.

Special Schools.

First in this class come the military schools, which are divided into schools of education and schools of military instruction.

The military schools of education are subdivided into schools for non-commissioned officers and schools for officers.

The schools for non-commissioned officers are:—The lower schools of education; the superior schools of education; the company schools.

The schools for officers are:—The cadets' school (*Cadetten Institut*); the military academies.

The military schools properly so called:—The institute of military professors (*Militär-Lehrer Institut*); the higher school of artillery; the higher school of engineers; the central cavalry schools; the war school (*Kriegs-Schule*); the school of military administration; the Joseph Medico-chirurgical academy; the veterinary institute; the school for officers' daughters, at Hernals.

Establishments of Military Education.

The object of these schools is to prepare the sons of poor persons, who have done good service in the army to become non-commissioned officers and officers. In these establishments there are military pupils (*Militärzöglinge*) and pupils who pay or are supported by exhibitions founded by provinces or private individuals.

Admission as *Militärzöglinge* is granted to the sons of soldiers or civil servants who have served a certain term, and in the company schools the sons of civil servants and frontier guards. The conditions of admission to scholarships founded by provinces or private persons are determined by the deed of endowment. Every Austrian subject has the right to enter as a paying pupil on condition of lodging a year's schooling in the military chest, and of possessing the other qualifications required. Paying pupils are admitted into all the military establishments except the lower schools. Foreigners may also be admitted as paying pupils, on producing a formal authorization from their own government to enter the Austrian service. To be admitted, candidates must have the age required for each school, be well grown and of good constitution, and possess the proper degree of instruction.

The teaching in each school is regulated by a fixed plan of studies, which may be modified according to the progress of science and in accordance with educational improvements. The curriculum in the schools for non-commissioned officers comprises: religion, the German, Bohemian, Hungarian, Italian, and Roumanian languages, mathematics, popular mechanics, the rudiments of physics, the elements of civil architecture, geography, history, natural history, literary compositions on military subjects, the knowledge of infantry arms and of artillery, the pioneer service, fortifications, instruction in sapping, in mining, the regulations for teaching and exercising recruits, fencing, campaign service, gymnastics, swimming. For the officers' schools: religion, elementary philosophy, the German, French, Bohemian, Italian, and Hungarian languages, mathematics, mechanics, practical land-surveying, physics, chemistry, descriptive geometry, geography, history, natural history, international law, Austrian law, military penal code and forms of procedure, rhetoric, military style, the knowledge of artillery, fortification, instruction of sappers, service and regulations for the drilling of recruits and manœuvres, campaign service, drawing, gymnastics and fencing.

In the course of September, the pupils of the last year in the company schools enter the army as non-commissioned officers; those of the academy as officers. At the same time, the pupils of the last year in the inferior schools of education pass into the higher school, and thence into the company schools and into the cadets' institute. The other pupils pass into the class immediately above. Pupils who have not made sufficient progress are sent back to their parents except soldiers' children, who in certain cases, are allowed another chance. Those who leave before the end of the studies cannot, if they enlist either immediately or later, be promoted to any rank, especially to that of officer, before their comrades of the same standing leave the schools.

The length of the studies in these schools is for the—

5 lower schools, having each		100 pupils,	4 years' study.	
5 higher schools,	„	200 „	4	„
2 company schools for	infantry,	120 „	2	„
4 „ „	artillery,			
1 „ „	pioneers,	120 „	3	„
1 „ „	engineers,			

4 cadets' schools (*Cadetten Institut*) 200 pupils, 4 years' study.

For the military academies, viz.:—

The Neustadt Academy, 400 pupils, 4 years' study.

The Academy of Artillery and Engineers, 160 pupils, 4 years' study.

In a lower school the command is given to a subaltern; in a higher or a company school, to a captain; in a cadet school to a staff officer; in an academy to a general. Each school has its own staff for teaching, supervision, and manœuvres, as well as for health and service. The religious instruction is given, partly by ecclesiastics attached to the establishment, partly by civil or

military chaplains. The other matters are taught in the lower schools by non-commissioned officers; in the higher and the company schools by officers and serjeants; in the cadet schools by officers from the rank of captain downwards; in the academies by staff officers. In the academies, the pupils are also taught riding. Each school of non-commissioned officers has a surgeon-major; each cadets' school, a regimental surgeon; and each academy, a staff surgeon and a superior surgeon.

Institute for Military Teachers.

This school is situated at Neustadt (a suburb of Vienna), and is intended to train teachers for the schools for non-commissioned officers, and serjeant-instructors for the officers' schools; masters of arms and teachers of gymnastics for the two kinds of schools and for the troops are also trained here. The pupils, 50 in number, are non-commissioned officers. The course of instruction is completed in a year. The establishment is directed by an officer of the staff, who has under him instructors, officers and serjeants.

Schools of Artillery and Military Engineering and School of War.

These establishments are intended to supply officers capable of receiving a higher degree of instruction, calculated to render them fit for the higher services of the army. The higher class of artillery is united to the academy of artillery at Weisskirchen, and that of engineers to the engineer academy at Znaim.

The School of War (*Kriegs Schule*) at Vienna forms a separate establishment, with a general at its head, and under him professors, for the most part staff officers, who are generally attached to the quartermaster-general's staff. The pupils are lieutenants and sub-lieutenants, who are admitted after passing an examination.

The studies last two years in each of these establishments, on leaving which the artillery and engineer officers enter their respective corps, and the officers of the *Kriegs Schule* join the staff of the quartermaster-general, as vacanies occur.

Central Cavalry School at Vienna.

This school has for its object to teach the more talented officers how to break and train horses, to manage and utilize them, and to handle and employ cavalry to the best advantage. The instruction occupies a year, and one officer is admitted from each regiment of cavalry. The head of the establishment is an officer of the staff or a general, the instruction is given by a cavalry officer and a veterinary surgeon.

School of Military Administration at Vienna.

The school has two subdivisions, one for military law, the other for the military administration of the frontiers. To the course

of the former the persons employed in the auditoriat are admitted; the instruction lasts one year, and on leaving the pupils receive appointments in that department. The school of military administration of the frontiers is open to subaltern officers, non-commissioned officers and civil candidates, after an examination. The instruction lasts over two years, after which the officers pass to the administration of the frontiers with their respective ranks; the non-commissioned officers and pupils are promoted in the same administration to the rank of sub-lieutenant of the second class. The commandant of the War School directs the establishment. The instruction is given by officers of the auditoriat, of the commissariat, and of the military frontier administration, and also by civil professors.

The Joseph Medico-Chirurgical Academy at Vienna.

This establishment is intended to prepare surgeons and physicians for the army, and to promote the study of medicine generally. It is subdivided,—1, into a superior course to form physicians surgeons; and 2, into lower courses to educate surgeons for the humbler services in campaigns. This academy ranks with the Vienna faculty of medicine

The higher instruction extends over five years, the lower over three years. Pupils who have gone through the higher course hold the rank of superior surgeons (*Oberärzte*) with the diploma of doctor, and are bound to ten years' military service. Those educated in the lower school have the rank of under-surgeons (*Unterärzte*), and must serve a term of eight years in the army.

The administrative, military, and disciplinary command is entrusted to an officer of the staff; a director of studies manages the scientific part, and the medical instruction is given by military physicians and civil professors.

Military Veterinary Institute at Vienna.

The object of this establishment is to train veterinary surgeons and farriers for the army and private practice, and to promote the progress of veterinary science. The mammalia of all species, whether belonging to the army or the public, are admitted to its hospitals; the professors also act as high scientific authorities in judicial proceedings relating to animals, and give consultations on questions raised by the authorities. The institute comprises:—1, a veterinary school, for surgeons and farriers; 2, school for farriers and shoeing smiths, and for the instruction of private persons practising those trades.

The conditions of the command and management are the same as in the Joseph Academy. The teaching staff is composed of five titular and five assistant professors. For subjects not within the province of the ordinary professors, the ministry of war appoints auxiliary masters. Shoeing horses is taught by two professors aided by two military farriers. The course of the veterinary school is three years for regular pupils, two years for veterinary surgeons and farriers.

Pupils on leaving the veterinary school receive a diploma of the second class, and are bound to serve six years in the army. The military pupils, after their two years' studies, rejoin their corps and are appointed farriers as vacancies occur.

Institute for educating Officers' Daughters at Vienna.

At this institute the daughters of officers with limited means and large families are educated so as to be able to take situations as governesses in wealthy families.

The pupils are 78 in number, and the expense of the establishment is defrayed by the Government and private benefactions. Girls are admitted from six to eight years of age, and remain till they are 20. The pupils are distributed into four classes and each class has two divisions. The directress of the establishment has under her orders four sub-directresses, a mistress for needlework, and a mistress to teach housekeeping. This instruction in household management is a desideratum in French education.

Schools for the Navy.

There are in Austria the following naval schools:—One for sailor boys (*Schiffsjunge*), for marines, for quartermasters, for naval pupils of the first class, for naval pupils of the second class, a theoretical school for naval cadets, and a superior establishment for naval officers.

The school for sailor boys is intended to train, as petty officers for the navy, young men from the Slave and German provinces, admitted between 12 and 14 years of age into the naval service. The instruction lasts until the pupil has attained the age for the conscription; he is then entered as a sailor and becomes a petty officer as soon as he gets sufficiently used to the sea. The highest post he can attain is that of upper boatswain (*Hochbootsmann*).

The schools for marines (*Zeugscorps*) receive men drawn from different corps of the army. They are trained as petty officers, and a part receive the uniform. Those who are fit to become officers receive their promotion when they leave their corps to enter the school.

The school for pupils of the first class is kept on board a war-vessel selected for the purpose. The object is to prepare for the naval service youths of 16 or 18 years of age, who, on entering the school have already received a complete civil technical education. The teaching here consists, therefore, chiefly of practical seamanship, and also of the application of previously acquired scientific knowledge to navigation and nautical astronomy. The course occupies a year; on leaving, the pupil is received as a naval cadet. After passing two or three years at sea these cadets enter the theoretical school for naval cadets.

The school for pupils of the second class is intended solely to prepare them to become officers. In this school, beside the pupils placed there at the cost of the State, there are others maintained by endowments, and also others who pay for their instruction. The sons of officers and State functionaries are entitled to enter this school at the public expense, and any Austrian subject who has the necessary qualifications is admitted on payment. Foreigners are also admissible as paying pupils, provided they can obtain authorization from their own Government to enter the Austrian service. To be admitted, candidates must be between 12 and 14 years of age, of sound health without bodily defect, and able to pass a previous examination. The instruction is given in accordance with a determined plan, on board a vessel prepared expressly to receive the pupils. After three years' instruction the pupils leave the school as naval cadets and are sent to sea. At the end of two or three years' active service the cadets are admitted to the theoretical school. This school receives from 40 to 50 pupils. The chaplain on board is charged with the religious instruction; the other teaching is given by professors from the hydrographic schools. The naval officers of the school-ship give the instruction in practical seamanship.

The theoretical school for naval cadets is on shore, and its course occupies a year, after which the pupil undergoes the examination prescribed for his commission as an officer. On leaving this theoretical school the pupils are still naval cadets, but become officers when appointed to a ship.

The superior school for naval officers is intended for the further improvement in mathematical and hydrographic studies, of such young men as have shown decided talent and taste for those sciences.

Superior Instruction.—Universities.

The empire of Austria has eight universities; viz., those of Vienna, Prague, Pesth, Cracow, Padua, Lemberg, Gratz, and Inspruck. The first four have four faculties, theology, law and administration, medicine, and philosophy. The university of Padua has five faculties, the fifth being for mathematics. The last three have only the faculty of medicine.

The universities are divided into faculties, and these comprise the council of professors and the students. The college of teachers (*lehrer collegium*) is composed; 1, of the ordinary and extraordinary professors, of private tutors (*privat-docenten*), and special professors, such as professors of languages, of gymnastics, &c., that is to say, those who do not teach a science but an art or an accomplishment. The college of teachers (*lehrer collegium*) elects from among its members a college of professors (*professor collegium*), which is the immediate directing authority of each faculty. The *professor collegium* is composed of all the ordinary professors, the senior extraordinary professors, and two private tutors (*privat-docenten*). The dean (*decan*) is elected

every year from the corps of ordinary professors. From the college of professors also is chosen every year the academical senate, the supreme academical authority. It consists of the rector, the pro-rector, the deans (*decanen*), and vice-deans of the *professor collegium*. The rector is elected every year by each faculty in turns.

At Vienna and Prague each faculty is divided into two colleges, that of professors and that of doctors with diplomas. At the head of the doctors is an elected dean, who has a seat and a vote in the respective college of professors; but in the academical senate (which, at Vienna, is called the consistory of the university), this right is granted him only on condition that the *doctoren collegium* reciprocally grants the same right to the dean of the *professoren collegium*. The elected dignitaries of the university are submitted to the approbation of the ministry.

The professors have the position of Government officers. They are appointed by the emperor. Their remuneration is composed: 1, of a fixed salary with a decennial augmentation, of fees from their auditors, and of examination fees. The fixed salary of a professor is not limited by any law. The minimum salaries which serve as the basis when a chair becomes vacant and is offered for competition, vary in the different universities from 1,050 to 1,680 florins. The decennial augmentations are from 210 to 315 florins. The extraordinary professors receive fixed salaries ranging from 600 to 1,260 florins.

Every one who wishes to profess courses as a private tutor (*privat-docent*) in a university must previously pass an examination before the college of professors. If he succeeds, a certificate of aptitude is given to him which must be confirmed by the ministry. The private tutors have no salary, but receive fees from their hearers. Those who give proofs of capacity are afterwards named extraordinary professors; they generally become ordinary professors after a time, so that the private tutors (*privat-docenten*) are a kind of nursery for university professors. Of the masters (*lehrer*) properly so called, some have salaries while others have not, but they also are allowed to take fees from their hearers.

The students of the courses of the faculty are ordinary pupils (*ordentliche*) or free pupils (*ausserordentliche*). The former alone share the rights enjoyed by the members of the university, and they only are admitted to examinations for the doctor's degree, or for all the Government employments for which university degrees are a necessary qualification. As a general rule those only are allowed to enter themselves who have obtained a certificate of maturity on leaving the gymnasia.

The matriculation fee amounts to 2·1 florins. Free students must be at least 16 years of age, and possess sufficient instruction to understand the subjects explained in the lectures.

The studies are divided into two half-yearly terms. The winter term commences on the 2nd of October and ends on the Thursday preceding the Holy Week. The fees for each course are available for a half-yearly term. Students are free to follow what courses

they please, provided they select such as satisfy the conditions of the examination for the doctor's degree or for the Government employments when they present themselves. The time which they have passed at foreign universities, where the studies are equally free, may be counted to them under certain conditions, and foreigners also may matriculate in Austrian universities. The length of the studies is in general four years for the faculties of theology, law, and administrative science; five years for medicine, and three years for philosophy. Students are bound to attend the courses regularly, otherwise their inscriptions may be cancelled.

Students pay nothing for attending the university in general, but they must pay into the university treasury, for the courses they attend, the regulation fees which, after deducting 5 per cent. for expenses of collection, are divided among the respective professors. The minimum fee for a course is fixed at as many florins as there are lectures in the space of a week. For the optional courses the *privat-docent* is allowed to augment the charge as he pleases. The college of professors may remit one half or even the whole of the fees in favour of poor and industrious students.

Schools for Midwives.

There are eight schools of this kind, at Linz, Klagenfurt, Laybach, Trieste, Alle-Laste near Trent, Zara, Venice, Czernovicz. Instruction of the same kind is also given to women at the faculties of medicine and surgical establishments. A large number of apprentice-midwives receive considerable pecuniary assistance during their studies from the provinces and townships.

Candidates must be at least 24 years of age, and less than 50, must be able to read and write, be of good reputation, and of healthy constitution. The course of instruction occupies, according to circumstances, four, five, or six months. It is both theoretical and practical, and is given by a professor of obstetrics, aided by a midwife and a nurse. In most of the schools there are two promotions yearly. On leaving, the pupils have to undergo a severe examination, for which those who have the means pay a fee of 30 florins. There are ten professors engaged in these schools, with a like number of midwives and nurses. The professor's salary is from 420 to 630 florins. More than 1,200 midwives are instructed every year in these establishments. The expenditure amounts to 9,815 florins.

Technical Institutes.

These establishments are intended to educate young men:— 1. For the higher branches of industry and trade. 2. For farming on a large scale. 3. For various public and private employments which require superior technical knowledge.

Besides the faculty of mathematics at Padua, there are at present in Austria seven higher technical schools: these are the

Polytechnic institutes at Vienna and Prague, the technical school at Brünn, the technical academy at Lemberg, the technical institute at Cracow, the Joseph *Polytechnicum* at Ofen, and the *Joanneum* at Gratz. Some of the technical institutes are complete, that is to say, they embrace both technical and commercial education, others, as those of Prague and Ofen, are incomplete, as they give technical instruction only. The Vienna Institute has a preparatory school, and a school of industrial drawing; that of Cracow has a school of fine arts, and one of music; that of Ofen a preparatory school.

Each institute has a director (at Vienna there is also a subdirector), who is aided in all matters concerning the teaching and discipline by the council of professors. The educational staff consists of the professors, who are distinguished as ordinary and extraordinary, and have the same rank as university professors, of private tutors (*privat-docenten*) of the same rank as in the universities, of masters (*lehrer*) ordinary and extraordinary, and for the experiments, of assistant teachers.

The pupils consist of ordinary, extraordinary, and free pupils. The ordinary or matriculated pupils are young men who have followed the courses of a common gymnasium, or of a superior or practical school, or those who, being 16 years of age, have passed a satisfactory examination for admission. Persons of mature age and students from the higher educational institutions are admitted as extraordinary auditors, if they do not possess the qualifications required for ordinary pupils. The designation of "free pupils" is given to those who wish to follow only certain courses, not forming a complete branch of studies. The ordinary pupils are free to choose what courses they will follow, provided they are sufficiently prepared.

The following are the subjects taught in the technical institutes:—

Elementary and higher mathematics; descriptive geometry and drawing; technical physics; theoretical mechanics; the construction and drawing of machines; ordinary and higher land-surveying, and the drawing connected therewith; the applications to bridges and roads, with drawing; natural history; general technical chemistry; mechanics and applied chemistry; political economy and management of estates; forest encyclopædia; national economy; statistics; the science of organization and administration; commercial and industrial legislation; geography and history; account keeping; political arithmetic; commercial arithmetic and book-keeping; the art of writing; the knowledge of raw produce and merchandise; the Italian, French, and English languages and literatures; caligraphy; stenography; elementary and ornamental drawing; and modelling. The Vienna Institute also teaches the Turkish language, the Persian language, vernacular Arabic, and some other optional subjects. Those branches of instruction which require experimental demonstrations have collections of instruments and cabinets placed under the direction of the professors, as well as an annual fund for keeping them in order, and making additions.

The ordinary and extraordinary pupils receive certificates of attendance, which are delivered by the respective professors, and countersigned by the director. At the end of each year the ordinary pupils may pass examinations in the subjects of the courses they have followed, and their proficiency is proved by certificates which have an official value. The extraordinary pupils may likewise obtain certificates.

In 1859, the number of professors in all the technical institutes was 157, and of auditors 3,531, of whom 752 were free pupils. This total of auditors was thus divided among the different institutes:

	Professors.	Students.	Free Pupils.
Polytechnic Institute of Vienna -	54	1,963	723
Do. of Prague -	25	617	„
Technical Establishment at Brünn -	13	196	„
Technical Academy at Lemberg -	11	229	„
Technical Institute at Cracow -	14	171	6
Joseph's Polytechnicum at Ofen -	24	201	„
Joanneum Polytechnicum at Gratz -	16	154	23
		3,531	

Mathematical Faculty at Padua.

This faculty may be classed with technical institutes, its object being to train young men for engineering and other technical professions. The instruction given is altogether practical. Candidates for admission have to produce certificates that they have satisfactorily passed through the complete course of a gymnasium or practical school. The instruction extends over three years, but pupils may remain longer, if, instead of attending all the courses of a year, they leave a part of them for the next year.

1st year's studies.—Introduction to the higher mathematics; land surveying; hydrometry; geometrical drawing; agriculture; and natural history.

2nd year's studies.—Higher mathematics, differential and integral calculus; civil and hydraulic constructions; descriptive geometry; architectural drawing.

3rd year's studies.—Applied mathematics; civil and hydraulic constructions; architectural and machine drawing; legislation affecting engineers.

There are also, not for all the students, but only for those who desire a more special instruction, courses on the construction of machines, technology, &c. All the other branches necessary for technical education, such as physics, chemistry, &c., are also fully taught in the faculty of Padua. Engineers have to undergo an examination for the doctorate, before the mathematical faculty in the university, and further, to qualify themselves for the service of the State, they must also pass a special examination in the details of the service.

In the faculty of mathematics there is likewise a class of one year for the instruction of land surveyors and conductors of works. The courses are as follows:—Civil constructions and roads; geometrical and architectural drawing; elementary land surveying; agriculture; natural history; and legislation affecting engineers.

The number of students in the mathematical faculty ranges from 250 to 300.

Polytechnic Institute at Prague.

The Polytechnic Institute is intended to give the pupils who follow its studies a fundamental scientific education adapted to the profession they mean to adopt, and to make them so well acquainted with technical and scientific progress that they may be able without further preparation to enter on the duties of practical life. To attain this end, the instruction is distributed in four special divisions:—

A. Division, bridges and roads and civil engineering (*Wasser und Strassenbau*).
B. Division of architecture and civil buildings (*Hochbau*).
C. Division of the construction of machines (*Maschinenbau*).
D. Division of applied chemistry (*Technische Chemie*).

The following is the general programme of the instruction which is common to all the pupils:—

I.—*Mathematics. Three courses of a year each.*

1st Course.—Algebra, analysis, elements of differential calculus, analytical geometry, plane and solid (7 hours). *2nd Course.*—Higher equations, integral and differential calculus, with applications to geometry (6 hours). *3rd Course.*—Differential equations, variations, calculations of least squares (5 hours).

II.—*Descriptive Geometry.*

1. Orthogonal projections, oblique and polar in general, with a view to technical applications (5 hours); drawing of buildings (10 hours). 2. Stereotomy, application of descriptive geometry to cutting of stones and voussoirs (2 hours); execution of models in stone-cutting (4 hours).

III.—*Land Surveying.*

1st Course.—Surveying, levelling, theory and description of instruments and apparatus (5 hours); topographical drawing from models (6 hours); practical surveying and levelling in the field (14 days in the year at least). *2nd Course.*—Contouring; geodesic levelling (3 hours); practice in the field (for 8 days in the year at least).

IV.—*Mechanics and Construction of Machines.*

1. Elementary mechanics, terrestial statics and dynamics, hydrostatics, hydrodynamics, aerostatics and aerodynamics (3 hours). 2. Analytical mechanics, in the summer term (5

hours); 3. Mechanics of constructions (3 hours); drawing of machines (6 hours). 4. Study of machines, application of mechanics to the theory and the drawing of machines (no time specified). 5. Construction of machines, knowledge of materials, and instruction in certain kinds of machines (5 hours). 6. Encyclopædia of machines, for pupils not destined for any specialty (5 hours), drawing of machines (6 hours). 7. Practical construction of machines in the workshop (at least 4 hours).

V.—*Technological Mechanics.*

Working of metals, wood, textile substances, spinning, manufacture of woollen tissues and of paper (5 hours).

VII.—*Architecture and Civil Engineering.*

1st Course.—Mason's and carpenter's work, constructions in iron, materials of formations and stability of buildings (4 hours); designs of construction (no time given). *2. 2nd Course.* —Technical study of edifices, preparatory works, &c. (5 hours); drawing of buildings (6 hours). 3. *3rd Course.*—Project of a large building from a given programme (12 hours); 4. Studies of style with drawings (courses of 6 hours each); modelling in clay (6 hours).

VII.—*Hydraulic Construction and Road-making.*

1st Course.—Foundations, embankments, lakes and canals, construction of roads, resistance of bridges and railways (5 hours); drawings of constructions (no time given). *2nd Course.* —On bridges and railways (5 hours); drawing of ditto (8 hours); projects of hydraulic constructions and roads from a given programme (8 hours).

VIII.—*General notions on Hydraulic Works and Road-making.*

For pupils not destined for any speciality of construction (5 hours); drawing of buildings (6 hours.)

IX.—*General Physics.*

1. Statics, dynamics, magnetism, electricity, heat, optics, acoustics (5 hours). 2. Technical physics: application of physics to technical questions and industry, pyrotechny, telegraphy, galvano-plastics (2 hours).

X.—*General Chemistry.*

1. Raw materials and their uses; working of metals, alloys; study of salts; organic chemistry (7 hours). 2. Analytical chemistry: use of the blow-pipe; qualitative and quantitative analysis, in winter (5 hours); practical analysing in the laboratory (two courses of 15 hours each). 3. Technological chemistry: *1st Course.*—Chemical fermentation (in winter); agricultural chemistry, bleaching and drying (in summer, 5 hours). *2nd Course.*—Manufacture of sugar (in winter, no time specified); manufacture of glass, chemistry of salts (in summer, 5 hours). 4. Chemical encyclopædia, for pupils not intending to follow any chemical specialty.

XI.—*Mineralogy.*

Considerations on the technical and industrial applications (in summer).

XII.—*Geology and Palæontology.*

Considerations on their technical and industrial bearings (3 hours).

XIII.—*Botany.*

Considerations on the technical and industrial applications (in summer, 3 hours).

XIV.—*Zoology.*

Considerations on the technical and industrial applications (5 hours).

XV.—*Free-hand Drawing.*

According to the special objects of the technical studies (4 hours).

The course of special instruction occupies five years for the first three divisions of the first category of pupils (bridges and roads, architecture, construction of machines), and four years for the fourth division (applied chemistry).

The subjects of instruction are spread over the successive years as follows :—

Division A.—*Bridges and Roads.*

First Year.—Mathematics, 1st course (7 hours); descriptive geometry (5 hours); working drawings (10 hours); general physics (5 hours); mineralogy (4 hours); free-hand drawing (4 hours). In all, 35 hours per week.

Second Year.—Mathematics, 2nd course (6 hours); land surveying, 1st course (5 hours); drawing of plans (6 hours); elementary mechanics (5 hours); general chemistry (3 hours); technical physics (2 hours). In all, 27 hours per week; and during the summer 14 days practical surveying in the field.

Third Year.—Mathematics, 3rd course (5 hours); analytical mechanics, and description of machines (5 hours); drawing of machines (6 hours); architecture (4 hours); drawing of buildings (6 hours); geology (3 hours). In all, 29 hours per week. Besides geological excursions.

Fourth year.—Road-making and hydraulic works, 1st course (5 hours); drawing for ditto (8 hours); architecture, 2nd course (5 hours); drawing for ditto (6 hours); mechanics of building (3 hours); cutting of stones (2 hours); practical modelling and stone-cutting (2 hours). In all 30 hours per week.

Fifth year.—Road-making and hydraulic works (2 hours); drawings for ditto (8 hours); drawing of projects (8 hours); technical mechanics (5 hours); land surveying, 2nd course (3 hours). In all 25 hours per week, and also at least a week in the year in visiting remarkable engineering works.

DIVISION B.—*Architecture and Civil Constructions.*

First year.—Same as Division A.

Second year.—Same as Division A, plus 6 hours per week for the study of style, 1st course.

Third year.—Same as Division A, plus 2nd course of style (6 hours).

Fourth year.—Same as Division A, plus 3rd course of style (6 hours).

Fifth year.—Architecture and civil constructions, 3rd course, drawing up of projects (12 hours); national economy (5 hours in winter, 4 hours in summer); account-keeping (3 hours); technical mechanics (5 hours); study of style, 4th course (6 hours); modelling (6 hours). In all 33 hours per week, besides visits to interesting constructions.

DIVISION C.—*Construction of Machines.*

First and second years.—Same as Division A.

Third year.—Mathematics, 3rd course, in winter; analytical mechanics, in summer (5 hours); drawing of machines (6 hours); encyclopædia of construction (5 hours); drawing of buildings (6 hours); geology (8 hours). In all 30 hours per week.

Fourth year.—Construction of machines (5 hours); drawing of ditto (10 hours); projects of ditto (5 hours); technological chemistry and metallurgy (2 hours); national economy, in winter (5 hours); account-keeping, in summer (3 hours); practice in workshop (4 hours at least). In all 35 hours, besides visits to great workshops.

Fifth year.—Practice in workshops.

DIVISION D.—*Technological Chemistry.*

First year.—Mathematics, 1st course (7 hours); general physics (5 hours); mineralogy (3 hours' lessons, 1 hour of application); zoology in winter, botany in summer (5 hours). In all 21 hours.

Second year.—General chemistry (7 hours); technical physics (2 hours); general mechanics (6 hours); drawing of machines (6 hours); geology (3 hours). In all 23 hours, besides geological excursions.

Third year.—Analytical chemistry, in winter (5 hours); analysis in laboratory (15 hours); technical chemistry, in winter (5 hours); agricultural chemistry, in summer (5 hours); encyclopædia of construction (5 hours); drawing of buildings (6 hours). In all 36 hours per week in winter, 31 in summer.

Fourth year.—Analysing in laboratory (at least 15 hours); sugar-making, ironworks, glass-making, pottery, and chemistry of salts (5 hours); national economy and account-keeping (4 hours). In all 29 hours per week.

It will be seen that in this programme the instruction given to mechanicians is continued without interruption for four years, and that practice in workshops is required only in the fifth

year, which appears preferable to the plan adopted at Dresden, of obliging the pupils to pass a year in the workshop after the first year's studies. But it is very probable that the pupils content themselves with the third year's study of their division, which, however, the programme seems to render difficult at the end of the first and the second year.

The institute has 20 ordinary professors, 11 extraordinary professors of the first class, 20 tutors, and 6 masters. The number of pupils in 1862–63 was as follows :—

Natives of	Prague - - -	120
„	Bohemia - - -	575
„	Moravia - - -	14
„	other parts of the empire -	38
		747

The age of the pupils ranged from 16 to 25, the great majority (526) being between 19 and 23.

The Prague Institute possesses numerous collections well supplied with the necessary appliances for teaching. They consist of—1. A library with from 10,000 to 12,000 volumes. 2. Complete sets of models for descriptive geometry, models of surfaces generated by straight lines, &c. 3. Instruments for topography, surveying, and levelling for the use of the pupils ; topographical models in relief (Bardin's system). 4. Models of machines in great number and variety ; parts of machines ; apparatus to demonstrate the laws of falling bodies ; dynamometers ; divers prime movers. 5. Instruments for physical experiments, comprising most of the new inventions in that department. 6. Technology —different tools ; raw products, &c. 7. Architecture—models in plaster ; handsome models of suspension and other bridges in wood, iron, &c. ; models of roofs and other carpenter's work. 8. Agriculture — well-executed models of farming machinery and implements. 9. Natural history and mineralogy—collection of minerals and rocks placed at the disposal of the pupils ; birds, reptiles, &c.

The institute has, for the study of applied chemistry, a very complete laboratory, in which 40 pupils can simultaneously perform the principal manipulations. The Prague Institute is the one where we found linear drawing in the greatest perfection. The lines are fine and light ; all the various kinds of working drawings are executed there, and the projects of public works, buildings, and machines are carefully got up.

Vienna Polytechnic Institute.

This institute, standing in one of the new quarters of the capital, is a very large establishment, with very extensive and complete collections, well classified, and kept in excellent order. They are open to the public on Sundays. There are at present 17 ordinary and 20 extraordinary professors, with 900 pupils, who study for five years, and pay 24 florins a year, but about one third of them are exhibitioners. The collections consist of

models of bridges, locks, &c. of boats, vessels, carriages of all kinds, hoisting apparatus, and weighing machines; dividing machines of various descriptions, hydraulic machines and apparatus, waterwheels, turbines, water-pressure machines, &c., stationary steam-engines, steam hammers, apparatus and machines for raising water; philosophical balances, dynamometers, clocks, locomotives, steam-boilers; a handsome model of Stephenson's slide; steam-boats, steam-dredgers; instruments for natural philosophy, barometers, optical instruments; an apparatus for firing mines, electrical machines, &c. &c. There is also a very extensive technological collection of raw products, tools, and manufactures of all kinds, including many very curious articles, some of which, owing to their perishable nature, have to be renewed occasionally. Very numerous collections of well-executed drawings, pasted on canvas, are placed at the disposal of the professors for their lessons.

The spacious, well-lighted, and ventilated class-rooms offer the pupils all the space necessary for the execution of their drawings. A workshop, in which 12 men are employed, manufactures and keeps in repair the instruments for topography, and land surveying necessary for the service of the institute; and as the master is authorized to sell his productions to the public, he receives no emolument from the institute beyond the free use of the workshop and tools. A very complete laboratory, with stoves ventilated to carry off the vapours, is large enough to accommodate from 40 to 50 pupils, distributed round tables, each with room for 10. To prevent the waste of re-agents the pupils have to pay for all they use.

According to the new statutes for the Vienna Polytechnic Institute, this establishment is intended to give theoretical instruction, as profound and practical as possible, in the sciences necessary for the various categories of pupils. The course of instruction consists of a preparatory division comprising two years' studies and four special divisions, viz. :—1. Bridges and roads. 2. Architecture. 3. Construction of machines. 4. Chemistry. The teaching commences on the 1st of October and ends on the 31st of July. It is divided into courses of a year, and courses of half a year.

The subjects taught are divided into six distinct branches, which are :—

A. Mathematics, descriptive geometry, practical geometry, higher land surveying, spherical astronomy, technical mechanics, analytical mechanics, general physics, technical physics, inorganic chemistry, organic chemistry, analytical chemistry, mineralogy, geology, zoology, paleontology, and botany.

B. Study of machines, general elements of machinery, construction of machines, mechanics relating to construction, general elements of the construction of buildings, architecture and the art of building; bridges and roads, railways, description of soils; technical chemistry, knowledge of merchandise, agricultural and forest economy.

C. General history, history of Austria, history of the building art, history of the inductive sciences; German literature;

æsthetics, political economy, statistics; mercantile law, law of exchange, maritime law; Austrian organization and administration; book-keeping.

D. Technical and free-hand drawing; decoration, and drawing of ornaments; landscape drawing; modelling.

E. French, Italian, and English languages,; stenography.

These subjects are distributed between the preparatory and special divisions, and nearly the same number of hours is allotted to each, as in the Prague Institute just described. The lessons in botany, zoology, geology, mechanical and chemical technology, construction of machines, art of building, and in the agricultural sciences, are followed by excursions and visits to establishments. The practical course of geometry is also terminated by important field operations.

The following is the programme of the studies with the number of hours per Week allotted to each subject, both in the summer and winter terms :—

Preparatory Division.

	Winter.		Summer.	
	Lessons of 1½ hours each.	Hours devoted to drawing.	Lessons of 1½ hours each.	Hours devoted to drawing.
First Year.				
Mathematics (1st course)	5	—	5	—
Descriptive geometry	3	8	3	8
Inorganic chemistry	2	—	2	—
Mineralogy	3	—	—	—
Geology	—	—	3	—
Technical and free-hand drawing	—	6	—	8
Total	13	14	13	14
Second Year.				
Mathematics (2nd course)	3	—	3	—
General physics	2	—	3	—
Technical mechanics	3	—	3	—
Practical geometry	3	6	3	6
Technical and free-hand drawing	—	8	—	10
Total	11	14	12	16

I.—*Division of Bridges and Roads.*

First Year.				
Stereotomy and perspective	—	—	3	6
Surveying	3	—	2	—
Analytical mechanics	3	—	—	—
Elements of machinery	3	6	3	6
Construction (1st course)	4	8	4	8
Total	13	14	12	20

I.—*Division of Bridges and Roads*—cont.

	Winter.		Summer.	
	Lessons of 1½ hours each.	Hours devoted to drawing.	Lessons of 1½ hours each.	Hours devoted to drawing.
Second Year.				
Technical physics	2	—	2	—
Applied mechanics	3	—	—	—
Mechanism	2	—	2	—
Land surveying	—	—	1	4
Bridges and roads	3	—	3	—
Projects and construction	—	15	—	15
Total	10	15	8	19
Third Year.				
History of constructive art	3	—	—	—
Organization of construction	1	—	—	
Construction of bridges	2	—	2	—
Construction of railways	2	—	2	—
Projects	—	15	—	20
Total	8	15	4	20

II.—*Division of Architects and Builders.*

First Year.				
Stereotomy and perspective	—	—	3	6
Elements of machinery	3	6	3	6
Constructive mechanism	2	—	2	—
History of constructive art	3	—	—	—
Architecture (1st course)	4	8	4	8
Total	12	14	12	20
Second Year.				
Technical physics	2	—	—	—
Applied mechanics	3	—	3	—
Elements of construction	—	—	3	6
Architecture (2nd course)	5	—	5	—
Architectural drawing and projects	—	14	—	14
Total	10	14	11	20
Third Year.				
Organization of construction	1	—	—	—
Architecture (3rd course)	3	—	3	—
Projects	—	15	—	15
Total	4	15	3	15

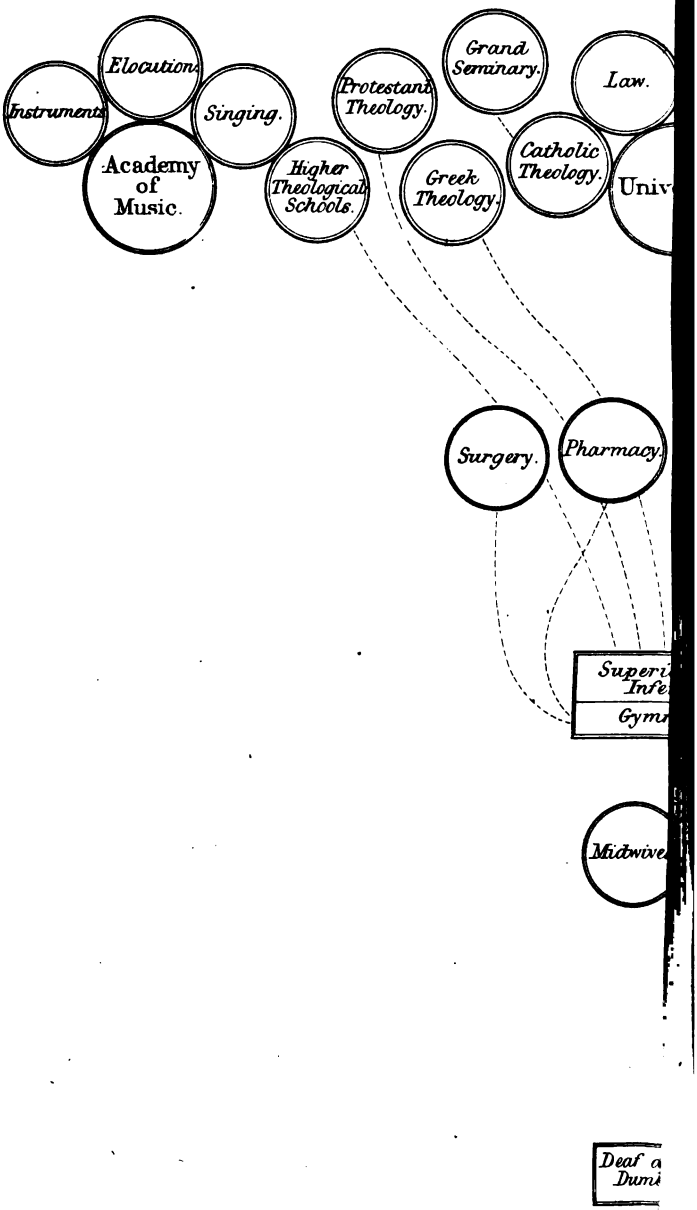
III.—*Division of Mechanicians.*

	Winter.		Summer.	
	Lessons of 1½ hours each.	Hours devoted to drawing.	Lessons of 1½ hours each.	Hours devoted to drawing.
First Year.				
Technical physics	2	—	2	—
Elements of construction	3	6	3	6
Analytical mechanics	3	—	—	—
Machinery	—	—	4	—
Machine construction	3	—	3	—
Manufacture of machines	—	10	—	10
Total	11	16	12	16
Second Year.				
Constructive mechanism	2	—	—	—
Applied mechanics	3	—	3	—
Apparatus for warming and lighting	1	—	—	—
Metallurgy	2	—	—	—
Machine construction	3	—	3	—
Projects and manufacture	—	15	—	15
Total	11	15	6	15

IV.—*Division of Applied Chemistry.*

First Year.				
General physics	2	—	3	—
Applied mechanics	3	—	3	—
Botany	—	—	3	—
Zoology	3	—	—	—
Organic chemistry	2	—	2	—
Analytical chemistry	1	—	—	—
Manipulation in the laboratory	—	10	—	10
Total	11	10	11	10
Second Year.				
Technical physics	2	—	2	—
Elements of construction	3	—	—	—
Technology of mechanics	3	—	3	—
Acquaintance with raw materials	—	—	2	—
Metallurgy and salt works	2	—	1	—
Materials for heating and lighting	1	—	—	—
Manufacture of salts, glass, &c.	—	—	3	—
Manipulation in the laboratory	—	10	—	10
Total	11	10	11	10
Third Year.				
Elements of machinery	3	—	3	—
Printing, dyeing, bleaching, &c.	5	—	—	—
Fermented liquors, manufacture of sugar, soap, stearine, &c.	—	—	5	—
Manipulation in the laboratory	—	15	—	15
Total	8	15	8	15

DIAGRAM OF THE



On considering the educational statistics of the Austrian empire it appears that the pupils are very unequally apportioned among the different technical institutes of the country, a fact which explains the difference in the amount of the expenditure of each. This, in 1862, amounted at Vienna to 110,960 florins; at Prague, to 41,000 florins; and in the other towns to 20,000 and between 30,000 florins. These figures, compared with the number of pupils, show that at Vienna each pupil costs about 56 florins, and at Prague 66 florins.

The yearly school fee is only 1½ florins per hour's lesson per week or 37½ florins, when the hour's lessons are 30 per week, and this number constitutes the complete special instruction. Many pupils are admitted gratuitously, and some few even receive pecuniary assistance to pay for their board and lodging. The following is a table giving the expenses at each establishment:—

Heads of Service.	Vienna.	Prague.
	Florins.	Florins.
Salaries of director and sub-director	5,400	630
Professors of the technical divisions	33,000	25,400
Officers, clerks, &c.	7,500	—
Industrial school of drawing	9,300	—
Expenses of administration	30,000	4,400
Collections and laboratories	8,400	4,000
Library	2,100	1,000
Lighting, firing, and cleaning	9,600	3,600
Repairs of buildings	5,000	2,000
Florins	110,300	41,030

The produce of the school fees and other receipts is, at Vienna, 18,850 florins, and at Prague 7,200 florins, about one-sixth of the whole; the rest is paid by State, the provinces, and towns.

A diagram in the form of a genealogical tree on the opposite page, gives a synopsis of the arrangement of the State educational institutions in Austria. It has been copied from a report on the schools of Vienna (*Bericht über die Austellung von Sckul und Unterrichts-gegenständen in Wien*), presented in 1862 to the Chevalier de Schmerling by Baron Helfert.

In this diagram we see clearly represented the system, still so imperfectly understood in England and France, of the separation of the pupils. Thus after following their elementary studies together as far as a certain point, they take different directions, some going to the gymnasia to continue those of literature, others to the practical schools specially intended for the study of the applied sciences.

In the gymnasia a similar separation takes place. Their lower classes prepare pupils for the schools of apothecaries, druggists,

the veterinary art, and clerkships, as well as for the lower agricultural, forest, mining, commercial, and industrial schools, whilst the upper classes lead to the universities and studies of a high order, to the faculties of Catholic theology, law, medicine, and philosophy, or in other cases to the Protestant, Greek, or other theological schools, and to what are called the academies of law, of oriental languages, and of rabbis. Lastly, these higher gymnasia also send pupils to the polytechnic institutes, and to the forest, mining, and agricultural academies.

In like manner the practical schools are divided into two categories: those of the lower order also lead to the special school for agriculturists, forest officers, miners, merchants, and manufacturers; those of the higher degree direct their pupils towards the polytechnic institutes, and thence towards the special divisions of civil constructions, bridges and roads, applied mechanics, and chemistry. In common with the higher gymnasia, they also lead to the academies for agriculture, forests, mines, and especially to those for the navy and commerce.

On the other hand, we see part of the children who have attended the primary schools proceed directly on leaving them to special practical schools of a humbler kind; as in the case of females, to the schools of midwifery, the higher schools for girls, and the normal schools for governesses; while the boys go to the Sunday schools, the schools for agriculturists, vine growers, gardeners, pilots, and miners. In the same rank as the primary schools, but distinct from them, stand the asylums which receive the blind and the deaf and dumb.

Besides these there are establishments of a totally different kind, viz., those devoted to the fine arts, such as the Conservatory of Music, with its schools of elocution, singing and instrumental music, the academy of fine arts, and the schools of painting, architecture, and sculpture.

This summary exhibits a completely organized system of education meeting all the requirements of the different classes of individuals of whom society is composed, and allowing every one to acquire, for the most part at little cost, the instruction suited to his capacity and position, which enables him at once to enter on the active duties of life.

SPECIAL REPORT ON THE EDUCATIONAL ESTABLISHMENTS OF THE KINGDOM OF BAVARIA.

PRIMARY INSTRUCTION.

Following the example of Prussia and Austria, primary instruction was made compulsory in Bavaria by a decree dated 9th July 1856, as regards children from six to 13 years of age. In the application of this decree allowances are made for the local and peculiar difficulties which may be opposed to its prescriptions; but in towns where such exceptional circumstances are rarely found, its enforcement is far more strict.

The master is bound to report the number of absent pupils to the magistrate charged with the supervision of the schools. A messenger is sent to ascertain the more or less valid reasons alleged in excuse, and a decision is taken inflicting a reprimand, a punishment, or a fine. None but the very poorest inhabitants are entirely exempt from paying the school fees, the amount of which, ranging from 7*d.* to 2*d.* per week, is fixed for each pupil by a special commission. According to an article of a decree dated 17th May 1860, parents of Christian communions whose children receive primary education at home or in private schools have to pay a yearly contribution of 3fl. 12kr.

The Bavarian primary schools generally have four classes, to which, in some places, as at Munich for instance, two higher classes are added under the designation of *improving* classes, in which children terminate their primary instruction in their twelfth or thirteenth year.

There were, in 1864, 8,260 primary schools for a total population of 4,500,000 inhabitants, which gives nearly two schools for every 1,000 souls. They are attended by 284,788 boys and 290,426 girls, in all 575,214 children, which corresponds to 1·44 schools for every 100 children between six and 12 years of age, or an average of 69 pupils for each school. Taking the whole kingdom, there is one primary school for every 570 inhabitants. The city of Munich alone, which contains about 100,000 inhabitants, has 21 primary schools of six classes, of which 10 are for boys, with 4,944, and 11 girls' schools, with 5,229 pupils, making a total of 10,203 pupils, which corresponds to about five schools per 1,000 inhabitants, and to an average of 486 pupils per school, and to 81 for each class. The teaching staff is composed of 170 masters and mistresses, or about eight teachers for each school, and an average of 60 pupils for each teacher, including the special masters for the two improving classes, such as professors of French, drawing, needlework for girls, &c.

The law, which makes primary instruction compulsory, without

any exception, is so well observed that there is scarcely any difference between the number of children bound to go to school and of those who actually attend.

In 1864, out of the recruits who joined the army, the number who could *read and write but imperfectly, or only read*, was but 8 per cent., a fact which proves the efficacy and the strict observance of the law.

The total expenditure of the kingdom of Bavaria amounts to 46,720,597 fl. Of this sum the State devotes to public instruction, science and art, the following items:—

Ministry of Public Instruction.

	Florins.	
Latin schools, gymnasia, lyceums - -	53,169	
Grants to primary schools - - -	414,113	
Supplements to salaries of teachers - -	16,000	
Deaf and dumb, blind, rickety children -	10,000	
Grants to educational establishments for teaching of music - - - -	15,381	
Higher scientific instruction - - -	377,020	
Fine arts - - - - -	16,824	
		902,507

Ministry of Trade and Manufactures.

Practical gymnasia and Polytechnic School -	110,000	
Veterinary schools - - - -	16,521	
Higher agricultural schools - - -	12,057	
		138,578
Total expenditure for education -		*1,041,085*

or about 0·022 of the whole expenditure of the kingdom. It is necessary, however, to observe that the primary, the industrial, the lower agricultural schools, and in general everything connected with the lower technical instruction, is considered as belonging to provincial and parish expenditure.

Technical Instruction.

The system of industrial education adopted in 1864 has recently undergone important modifications, which have been suggested by experience, and are well deserving of attention. In the order of things established in virtue of a new law which was passed after long discussions, the trade schools were to draw one part of their pupils from those educated in the primary schools, and the other from those of the Latin schools, which have four classes; the pupils from the latter, however, were to begin with the second year's course of studies. On the other hand, the instruction given in the trade schools, which have been somewhat ambitiously called *scientific gymnasia*, was of an order high

enough to enable those who had received it entire to enter the polytechnic institutes.

But the differences in the origin and preparation of the pupils of these schools opposed a serious obstacle to the progress of the teaching, and it was likewise ascertained that, if the pupils who entered polytechnic institutes from the literary gymnasia appeared at first inferior to the others for scientific studies, they generally, at a later period, attained the superiority over those from the scientific gymnasia. The pupils from these last-named establishments were also open to the reproach of not possessing sufficient literary instruction, of being unable to express their thoughts in a clear and elegant style, and of being common-place both in thought and language. Five years since the Bavarian Council of Bridges and Roads had decided on admitting into the body of government engineers none but those who, before entering the Polytechnic School, had followed the complete course of the literary gymnasia. The Administration of Mines had also constantly required the same qualifications.

One of the distinguished men who for many years past have studied this important question, has explained the change which had come over his ideas on this matter. Being a devoted friend and successful cultivator of the sciences, he was persuaded that their study, the habit of following their methods of explaining and of applying their results, was calculated, as well as the culture of letters, to develope the intelligence and form the habit of clearly expressing thought in good language, at the same time that it was capable of giving a higher tone to mind. While professing chemistry, physics, and natural history in one of the first trade schools of the kingdom, he had strenuously supported this opinion, which greatly contributed to procuring him the appointment of professor in the Munich Polytechnic Institute, still retaining his chair in the trade school. In the first-named establishment he had to deal with pupils from the trade school or scientific gymnasium, and also with those from the literary gymnasium. But he soon made the discovery that though the pupils trained to scientific studies appear at first most competent to follow out their applications, those who come from the literary gymnasia, after completing their studies there, were not long ere they surpassed the others. This personal experience, after long and conscientious observation, won over this eminent professor to the opinion that the culture of letters gives the mind a clearness of conception and expression most favourable to the study of the sciences.

The experience of the military schools at Metz and Saint-Cyr in France has long since shown that the pupils who have been so fortunate as to combine advanced literary acquirements with the study of the sciences are nearly always those who attain most distinction in after-life.

The result of the criticism and discussion to which the old system gave rise is embodied in the new system which makes the trade schools (*Gewerbe Schulen*) a continuation of the primary schools, to prepare pupils for the schools of agriculture, commerce,

and ordinary industry. By the side of the literary gymnasia for classical studies there are now practical gymnasia (*Real gymnasien*) which impart a literary and scientific instruction sufficient for pupils who intend to enter the polytechnic institutes. This system is almost identical with that adopted in France in 1852, chiefly with a view to the literary instruction of youth destined for the public services, with this fundamental and advantageous difference, however, that in Bavaria the two kinds of establishments are separated instead of being united.

Under the present system the establishments for technical education are divided into—

1. Industrial or trade schools (*Gewerbe Schulen*), to which, according to local requirements, may be annexed special divisions for commerce, agriculture, &c.
2. Practical gymnasia.
3. A polytechnic school comprising four special divisions :— For constructions ; technical mechanics ; technical chemistry ; and commerce.

Industrial or Trade Schools.

These schools (*Gewerbe Schulen*) receive pupils from 10 to 12 years of age, on their leaving the primary schools (*Volk Schulen*), and are intended to give only a degree of instruction sufficient to prepare for the lower departments of industry. They comprise three years' study, to which, if considered desirable by the local administrations, a fourth year may be added, corresponding to the schools of agriculture and commerce, to which one year must also be devoted.

The following is the programme of these schools :—

Subjects of Instruction.	Hours' Lesson per Week			
	1st Course.	2nd Course.	3rd Course.	Totals.
Religion	2	2	2	6
German language	5	4	3	12
Geography	2	2	—	4
History	2	2	2	6
Arithmetic	5	—	—	5
Elements of natural history	4	4	—	8
Drawing and modelling	8	8	6	22
French language	2	2	2	6
Algebra	—	2	3	5
Geometry and trigonometry	—	4	2	6
Descriptive geometry	—	—	2	2
Physics	—	—	2	2
Chemistry	—	—	2	2
Elements of mechanics	—	—	4	4
	30	30	30	90

School of Commerce.

This school, which is merely a supplementary addition to the trade school, requires its pupils to follow the first two years' studies of the latter, and one year devoted to special subjects in three courses: the first for the French language and caligraphy; the second for commerce, arithmetic, and commercial science; with continuation of the study of French; the third for the continuation of commercial science and French; and comprising, in addition, the study of the English language, commercial geography, and the history of commerce.

School of Agriculture.

This school, like the preceding, is a special division of the trade school. After the first two years of the latter the pupils who intend to become agriculturists must pass a year in this division, where they follow three courses:—The first for the study of agricultural science and drawing; the second a continuation of the first, with the addition of arithmetic applied to agriculture; the third, also a continuation of the preceding, with applied geometry in addition. It is evident from these programmes that the instruction given in these schools is of no very high order.

In addition higher agricultural instruction is given in a special establishment, the school of Weihenstephan, of which an account will be found further on.

Altogether there are in Bavaria 30 industrial and agricultural schools, in 29 of which the course of study extends over three years.

The classical and literary instruction of the country is given for the elementary Latin classes, in seventy schools, called *Latin-schools* (*Latein schule*), and in twenty-eight complete gymnasia, comprising also the elementary classes of the preceding.

Practical Gymnasia (*Real Gymnasien*).

There are five gymnasia of this kind, four of them in the provinces east of the Rhine, and one in those lying west of that river. Their object is to give, in four years' study, after the elementary Latin schools, a literary and scientific education to pupils who intend to take situations in different branches of the public works, as well as to those who pursue engineering as a profession in private firms. The instruction required for admission into the practical gymnasia is such as may be obtained in the elementary Latin schools, viz., religion, the German language, history, geography, elementary mathematics as far as algebra, and an elementary acquaintance with Latin and Greek. The study of the dead languages is continued during the whole four years.

The number of hours per week devoted to the different subjects of instruction are:—

	Hours per Week.	
For literature:		
German language	9	
Latin	14	
French	14	
English	4	
History	4	
Geography	5	
		50
For drawing		24
For the mathematical sciences:—		
Geometry	7	
Algebra	9	
Trigonometry	2	
Descriptive geometry	5	
Higher mathematics	4	
		27
Mineralogy, natural history, and physics		14
Religion		8
		123

So that instruction in religion and literature occupies about one-half of the time, and that in the different sciences the other half.

The pupils who, on leaving these schools, receive a certificate of maturity, are admissible to the polytechnic institutes.

Polytechnic Institute (*Polytechnicum*).

According to the new organization adopted for industrial education in general, the instruction at the Munich Polytechnic Institute is divided among the four following specialties:— 1. Constructions. 2. Technical mechanics. 3. Technical chemistry. 4. Commerce.

The courses are distinguished into common and special. For the first two divisions, the common courses lasts two years, and the special courses the same space of time. The third division, for chemists, follows the common course during the first year, and then devotes two years to special courses. The fourth division, for commerce, is bound to follow the first year of the common course, and has only one year's special course.

The subjects of the different branches of instruction, and the

number of hours devoted to them weekly are exhibited in the following general programmes :—

Common Instruction.	1st Half-year. Hours' Lessons per Week.	2nd Half-year. Hours' Lessons per Week.
First Course.		
Analytical geometry	3	3
Differential and integral calculus	4	4
Analytical mechanics	5	5
Mathematical physics	6	—
Applied physics and experiments	—	6
Elements of construction of buildings	6	6
Elements of construction of machines	6	6
Free-hand drawing	6	6
Elementary mechanics	5	5
Zoology	5	—
Botany	—	5
Political economy	4	—
Languages — French	3	3
Languages — English	3	3
Languages — Italian	3	3
History of German literature	2	2
Second Course.		
Applied mechanics	5	5
Application of descriptive geometry	3	3
General chemistry	4	—
Special chemistry	—	4
Palæontology	4	—
Geology	—	4
Designs of buildings (details and forms)	6	6
Designs of machines, elements of construction	6	6
General knowledge of machines	6	6
Constitutional law, and laws concerning buildings	4	—
Languages — French	3	3
Languages — English	3	3
Languages — Italian	3	3
Totals	108	100

Technical Division.

1*st. Division for Construction.*—For admission to this division, pupils must be proficient in the following parts of the two preceding general courses:—Analytical geometry; the differential and integral calculus; analytical and applied mechanics; mathematical and applied physics; general and special chemistry; the application of descriptive geometry; palæontology; physical geography; drawing for construction of buildings and machines; free-hand

drawing; and political economy. The following is the programme ;—

	1st Half-year. Hours' Lessons per Week.	2nd Half-year. Hours' Lessons per Week.
FIRST COURSE.		
Common to architects and building engineers.		
General notions on civil buildings	2	2
Building materials and salubrity of houses	—	4
Cost price, estimates, and contracts	4	—
Drawing topographical designs	4	4
Special instruction for architects.		
Styles and history of architecture	4	4
Projects of large buildings	14	14
Drawing the figure and landscapes	4	4
For building engineers.		
Construction of bridges	4	4
Projects of bridges	8	8
Surveying and hydraulics	6	6
Knowledge of machines	4	4
SECOND COURSE.		
Instruction common to architects and building engineers.		
Projects of large buildings	6	6
Projects of construction in civil engineering	6	6
Stone-cutting and modelling	4	—
Laws affecting buildings	—	4
Special instruction for architects.		
History of architecture	2	3
Elements of the art of constructing roads, bridges, and hydraulic works	2	2
Mensuration	—	4
Projects of large buildings	12	8
For building engineers.		
Art of constructing roads and hydraulic works	6	6
History of civil engineering	2	2
Projects of engineering works	8	8
Totals	102	103

2nd. Division for Mechanics.—For admission to this division pupils must be proficient in the following branches of the two preceding general courses :–The integral and differential calculus ; analytical geometry ; the applications of descriptive geometry ;

mathematics and applied physics; drawing of buildings and machines; general knowledge of machines; general and special chemistry; geology.

	1st Half-year. Hours' Lessons per Week.	2nd Half-year. Hours' Lesson per Week.
First Course.		
Knowledge of machines	5	5
Systems of transmission of movement	3	3
Construction of machines	4	4
Projects of constructions	8	8
Knowledge of materials	4	—
Technical physics, pyrotechny	4	—
Mensuration	—	4
Drawing of plane	—	2
Political economy	4	—
Excursions	—	4
Second Course.		
Knowledge of machines	4	4
Construction of machines	4	4
Projects of constructions	8	—
Hydraulic constructions, and railways	3	8
Levelling, gauging, measuring the force of water-courses	—	—
Building of manufactories	—	4
Metallurgy	5	3
Technology (manufactures, constructions, machines, tools)	5	—
Excursions	—	5
Totals	61	58

3rd. Division of Technical Chemistry.—For admission to this division pupils must be proficient in the following branches of the two general courses:—Zoology; botany; palœontology; geology; mathematics and applied physics; general and special chemistry; drawing of buildings.

	1st Half-year. Hours' Lessons. per Week.	2nd. Half-year. Hours' Lessons per Week.
First Course.		
Elementary mechanics	5	5
Technical physics, theory of heat	4	—
Technical chemistry	5	5
Elements of machine drawing	6	6
Knowledge of building materials	—	4
Political economy	4	—
Manipulation in the laboratory	—	—

	1st Half Year, Hours' Lessons per Week.	2nd Half Year. Hours' Lessons per Week.
SECOND COURSE.		
General study of machines	6	6
General study of civil buildings	2	2
Metallurgy, mining	5	—
Physical chemistry	5	—
Technology	5	5
Manipulations in the laboratory	—	—
Totals	47	33

4th Division of Commerce.—The following is the programme ;—

	1st Half-year. Hours' Lessons per Week.	2nd Half-year. Hours' Lessons per Week.
Study of commerce and accounts	6	2
Commercial geography and statistics	2	2
History of commerce	—	3
Legislation relating to commerce and exchange	—	—
Commercial arithmetic	3	2
Political arithmetic	—	3
Knowledge of merchandise	3	2
Mechanics (as connected with conveyance)	—	—
Political economy	4	—
Constitution and administrative law	4	—
Languages — French	3	3
Languages — English	3	3
Languages — Italian	3	3
Commercial correspondence in French and English	—	3
Totals	31	26

The Munich Polytechnic Institute is installed in spacious premises; the amphitheatres and class-rooms are very large and well-lighted; the laboratories for the chemical students afford every convenience for practising manipulations. The rooms for drawing are provided with a fine collection of models in relief for the pupils to copy. The collections of models of machines and constructions are very extensive, and those of large bridges and works of art present specimens of all the newest arrangements. In 1864, the Munich Polytechnic Institute had 172 regular pupils and 102 free auditors. In 1862–63, there were 164 of the former, and 97 of the latter. The number of professors is 11, with four masters or assistant professors.

Polytechnic School at Nüremberg.

Under this name there is at Nüremberg an establishment for technical instruction, which counts 10 titular professors, 2 assistant professors, 59 regular pupils and 33 free pupils. The mechanicians' division comprises from 20 to 24 pupils. The instruction extends over three years; but, as a general rule, the majority of the pupils leave the school earlier to enter on secondary positions as mechanical engineers, builders, or chemists; those who aspire to higher positions complete their studies at the Munich Polytechnic Institute. The workshops attached to the school receive a few pupils who work from 20 to 30 hours a week.

The mathematical teaching in this establishment is of a high order, perhaps higher than is required for the end in view; and, considering the requirements of local industry, a single polytechnic institute, like that at Munich, appears to us sufficient; it would even be advantageous to transform this one at Nüremberg into a practical gymasium or a trade school.

High School of Drawing at Nüremberg.

In this town, so noted for its various manufactures, there are several drawing schools of different degrees, according to the trade the pupils intend to follow. The first and most important is the higher school of industrial drawing conducted by M. Kröling. It is justly regarded in Germany as the one which has rendered most services to industry. In order that the pupils may, in a few years, acquire some real skill, none are admitted but those who have already attained considerable proficiency, The principle adopted by the professor of this school is that, in order to form good industrial draughtsmen, the pupils must pass through all the degrees of artistic drawing, so that they may be able, in the very varied and different combinations required by manufacturers, to blend judiciously and harmoniously all the various kinds, without there being any necessity, as too often happens, for having recourse to one artist for the architectural part, to another for the figures, and to a third for the ornaments, &c.

As for the method of teaching, it is exclusively based on drawing from models in relief, graduated according to the proficiency of the learners, and advancing from the simplest models to the finest left by ancient art, and then to nature. The talented director expresses his antipathy to copying from lithographs, which he regards as caligraphy, not drawing. In accordance with these principles, he has formed for his pupils very fine and very complete collections of models. The teaching is distributed in three divisions:—1, drawing of ornament; 2, drawing from the antique; 3, drawing from nature. After attaining proficiency in drawing, the pupils pass on to modelling and sculpture in wood and stone; then, as soon as they have attained a certain degree of skill, they have to compose designs, and to model and carve them.

The general opinion of the persons who have made a study of questions connected with teaching, not only in Bavaria, but also in other parts of Germany, is that the Nüremberg school has contributed more than any other to the progress of the national industry. This progress is especially manifest in the very decided improvement in the manufacture of children's toys, which are one of the staple productions of the country. For some years past, the improvement in the forms of the articles, whether moulded in clay or sculptured in wood, with which the Nüremberg manufacturers supply the shops of Paris, has shown us that great progress must have been made in the teaching of drawing, and ample confirmation of this opinion may be obtained on visiting the higher drawing school of this town. The Parisian manufacturers, though superior in other matters dependent on the arts of design are, with regard to children's toys, very inferior to the Nüremberg artisans.

As a preparation for the higher drawing school, there is an elementary school with courses occupying two years. The first, of eight hours' lessons per week, is entirely devoted to free-hand drawing, beginning with exercises on straight lines and curves, on plane surfaces, on symmetrical and regular bodies, and on simplex and complex ornaments, finishing with compositions. The second course, of six hours per week, is devoted to drawing ornaments, to drawing from the round, from the antique, and also to drawing furniture.

Sunday School (*Sonntags-handwerkerschule*), at Nüremberg.

The establishment founded under this title combines the teaching of drawing, modelling, sculpture, and engraving, with elementary instruction in geometry, arithmetic, physics, and chemistry. The first and most important part of the curriculum is connected with the arts of design. The first and second courses, graduated according to the capabilities of the pupils, are devoted to free-hand drawing, ornaments, architectural drawing, with or without shading, figure drawing, geometrical drawing, and tinting in Indian ink. The third course has four divisions, according to the special destination of the pupils: the first division comprises everything connected with buildings, from the first details of masons' and carpenters' work to the types and styles of architecture; the second is devoted to joiners' work; the third to turners in wood or metal; the fourth to divers trades.

The second part of the curriculum teaches modelling in wax, clay, or plaster, engraving, and sculpture. The third is devoted to arithmetic and geometry applied to mensuration of superficies, solids, and to plotting. The fourth imparts the rudiments of physics and mechanics, so far as applicable to local industries. The fifth and last treats of industrial chemistry. These courses were attended, in 1864, by 228 pupils for drawing, and 1,354 hearers for the other courses.

SCHOOL OF AGRICULTURE AND INDUSTRY (*KREIS-LANDWIRTHSCHAFT UND GEWERBESCHULE.*)

Under this title Nüremberg has two educational establishments one for agriculture, the other for the industrial arts.

The School of Agriculture (*Kreis - landwirthschaftschule*) comprises:—1. A preparatory school. 2. A school of husbandry. 3. A school of agricultural science.

The first of these is intended to receive lads whose education has been neglected, and in it they are taught the following subjects:—

	Number of Hours per Week.
Religion	2
Principles of theoretical agriculture	2
Practical agriculture	4
Arithmetic	4
Reading	1
Caligraphy	4
German language	4
Geography	2
Natural history	2
Drawing	8
Total	33

The school of husbandry is intended to educate farmers, bailiffs, and managers. The instruction occupies a year, and embraces the following subjects:—

	Number of Hours per Week.
Religion	2
German language	4
Chemistry	2
Arithmetic	4
Geography	2
Drawing	3
Caligraphy	4
Theoretical agriculture	6
Practical agriculture	4
Total	31

The school of agricultural science is intended to render young men capable: 1, of managing and cultivating farms of moderate size; 2, of being admitted into a central school of agriculture, or into the Munich Veterinary School. The instruction occupies three years, and there were in 1862–63—39 pupils of the first, 18 of the second, and 15 of the third year; in all 72 pupils.

These numbers show that less than one-half of the pupils go through the whole course of studies. The school of husbandry had only two pupils, the preparatory school eight, which makes a total of 82 pupils, for whom there are 13 professors and three masters.

The programme of the school of agricultural science is as follows :—

Subjects taught.	Hours per Week.		
	1st year.	3d year.	2d year.
Religion	2	2	2
Theory of agriculture	5	7	4
Practical agriculture	12 to 30	12 to 20	12 to 30
Zoology	2	—	—
General and special botany	2	—	—
Pure mineralogy	—	—	1
Applied mineralogy	—	—	4
Physics	—	3	—
Chemistry	—	2	—
Arithmetic	4	4	—
Geometry	—	2	3
German language	4	4	3
Geography	4	—	—
Free-hand and linear drawing	6	4	4
Caligraphy	4	—	—
Anatomy and treatment of domestic animals	—	—	2

Central School of Agriculture at Weyhenstephan.

This establishment, which constitutes the Bavarian high school of agriculture, is intended to give theoretical and practical instruction to fit young men for the management of large farms and for the dependent industries. The studies last two years, and the instruction is given by nine professors and two assistant professors. The youths who attend this school are divided into two classes ordinary pupils and free auditors. There are about 20 of the former and 40 of the latter. To be admitted, the candidate must have attained 16 years of age, have followed the studies of an agricultural school (*Landwirthschaft Schule*) or of a trade school; he must also know enough Latin to understand the value of the terms borrowed from that language, and be able to undergo an examination on the subjects taught in those schools.

Owing to local circumstances the pupils are, contrary to the general usage in Germany, received as boarders; Bavarian subjects for 125 florins per half year, and foreigners for 150 florins. This charge includes teaching, board, and lodging; books and school necessaries the pupils find themselves. They also have to pay 2 florins per half year for the reading room. The free pupils pay 35 florins per half year for each course they follow, and may

obtain a certificate relative thereto. The courses begin on the 1st of October and end on the last day of of August, with a fortnight's vacation at Easter. At the end of the year, examinations are held and the deserving pupils receive certificates of aptitude.

The school is established on the royal domain of Weyhenstephan, which contains about 938 acres of arable and pasture lands. The live stock comprises all kinds of domestic animals, and there are also :—

Experimental fields for various cultures. A brewery and distillery. A nursery. A hop ground. A cheese dairy. Technological collections. A chemical laboratory. A collection of various seeds. A collection of the productions of the Bavarian soil. A cabinet of instruments for experimental physics. A collection of agricultural implements and models. A library. A plantation of mulberry trees for the study of silkworms. An anatomical collection for veterinary studies. The neighbouring forests offer opportunities for the study of resinous trees.

The instruction is distributed as follows :—

First Year.

Winter Term.	*Summer Term.*
Agricultural implements.	Practical farming.
Experimental chemistry.	Experimental chemistry.
Arithmetic.	Construction.
Elements of construction.	Drawing of plans, surveying.
Drawing of plans and farm implements.	Breeding of cattle, races, diseases.
Physiology of plants, agronomy, agriculture.	Physiology of plants.
Forest science.	Agronomy.
Anatomy, physiology, and dietetics of domestic animals.	Agriculture.
	Forest management.

Second Year.

Winter Term.	*Summer Term.*
Organization of rural economy and management.	Valuation of farm property, and book-keeping.
Agricultural chemistry.	Agricultural chemistry.
Roads.	Farm buildings, meadows, and draining.
Drawing of plans and farm implements.	Agricultural technology.
Breeding of cattle.	Breeding and rearing of cattle.
Veterinary police, warranty of cattle sold.	Veterinary police ; warranty of cattle sold.
Physical geography.	Physical geography.
Meteorology.	Meteorology.
Climatology.	Climatology.

Synoptical View of Education in Bavaria.

The diagram on the opposite page represents, under the form of a genealogical tree, the connexion and subordination of the different branches of instruction, as at present organized in Bavaria, from the primary school to the highest educational establishment. It also indicates by a grey tint the schools which are under the direction of the Ministry of Public Instruction, those which depend on the Ministry of Commerce and Public Works being left in white.

The duration of the studies being indicated for each subdivision, it appears:—1. That, at 14 years of age, a boy may begin his apprenticeship with an adequate preparation of seven or eight years' elementary studies. 2. That, at 15, he may have acquired the instruction necessary for trade assistants, farmers' sons, and clerks in manufactories. 3. That after four years' elementary study of Latin, and four more years of literary and scientific in a real gymnasium, that is, eight years after leaving the primary school, or at the age of 18, a young man may be admitted to the polytechnic institutes, which he will leave four years later, being then 22, with sufficient technical instruction to enter the public services of bridges and roads, mines, or forests, or to become a mechanical engineer. All the preceding branches of instruction, after leaving the primary school or the elementary Latin school, are dependent on the Ministry of Commerce and Public Works.

On the other hand, under the direction of the Ministry of Public Instruction, the primary schools, the elementary Latin schools of four years' study, the literary gymnasia of the same duration, followed by one year of philosophy, lead a young man, at 19 years of age, to the faculties of medicine, law, and theology, which require three years' studies, and to that of administration, which takes two years, so that, in these directions, complete studies may be terminated at 22, or even 21 years of age.

The whole arrangement of the plan of studies at present adopted in Bavaria appears to satisfy all the requirements of literature and science, as well as those of manufactures, trade, and agriculture. It moreover easily admits of all the additions which may be desirable for certain industries or local requirements, such as Sunday and evening schools for workmen, special higher schools for girls, apprentice schools, normal schools for teachers of either sex, &c., which we have not here mentioned.

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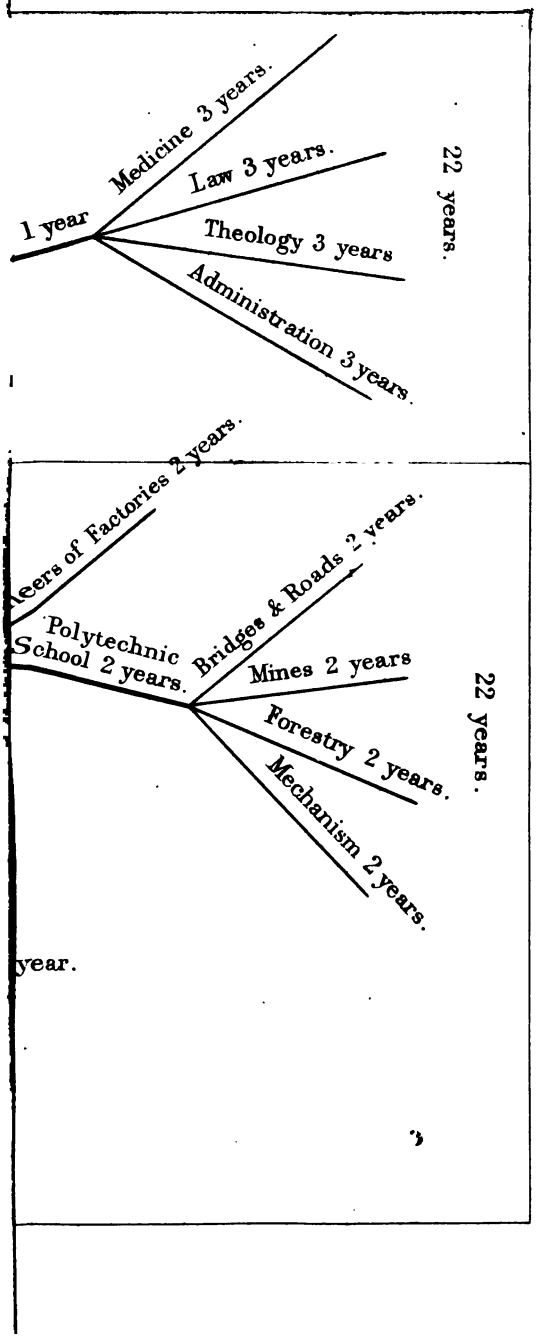

SPECIAL REPORT ON THE EDUCATIONAL ESTABLISHMENTS OF SWITZERLAND.

Every canton of Switzerland has its own laws and administration, and therefore the system of instruction may vary from one to another. In this report will be noticed the educational establishments of the canton of Zürich only, together with the Polytechnic Institute at the town of that name, which is a national institution, and intended for pupils from all parts of the Confederation.

In republican Switzerland, as in the different States of Germany, primary instruction is compulsory. It generally comprises six years' study, the first three of which are passed in what is designated the *elementary school*, and the other three in the *practical school*. These six years' study, which boys usually terminate in their twelfth or thirteenth year, may be followed by three years' study in the *secondary* schools, when any such exist in the township. On leaving the primary schools, at the age of 12 or 13, boys can be at once admitted to the cantonal schools, which present two principal divisions often occupying, as at Zürich, the same building, but quite distinct from each other, and following different lines of study. These divisions, called respectively a *gymnasium* and a *trade school*, prepare their pupils, the former for the universities and faculties, the latter for trades and for the Federal Polytechnic Institute at Zürich.

Primary Schools.

The primary schools are intended to bring up the children of all classes of the people according to uniform principles. These schools are distinguished into two classes, parish schools and district or secondary schools. In the canton of Zürich there are 11 of the latter.

All the children of the canton of Zürich who have attained their sixth year on the 1st of May are bound to attend the primary schools at the next resumption of studies after a vacation, which, under ordinary circumstances, usually takes place in May. Under this age children are not admitted to the schools. Attendance at primary instruction is compulsory until the age for confirmation (16 years). The inhabitants who have their children taught at home are bound to satisfy the authorities that the children receive an education at least as good as that of the primary schools, and they have to pay the school fees just the same until their children have attained the age fixed by the regulations.

The primary school is divided into two parts: the day school with six years' study, and the improvement school with three years. In addition to this all children, until their confirmation, are to attend the singing class, which is held once a week. The

three lower classes of the day school are called the *elementary school;* the three upper ones the *practical school.*

The time passed in school is—for the lowest class, 18 to 20 hours per week; for the second and third classes, 21 to 24 hours per week; for the three higher classes, 24 to 27 hours per week; and for the improvement school, eight hours, in two mornings, of four hours each. No professor can be required to give more than 35 hours of lessons per week, without counting the hours at gymnastics. The vacations are limited to eight weeks in the year.

In the day school the pupils are soundly initiated in elementary knowledge, viz., the Christian religion, the German language, arithmetic, and the elements of geometry; natural history, history, and geography, especially those of Switzerland; singing, writing, drawing, and general information; needle-work, &c. for girls. In the improvement schools every effort is made to apply what is learned to the practical uses of life. In every country district there must be at least one school for needlework and other female occupations, and the formation of ladies' societies to support and aid the mistress is encouraged. These societies are allowed a consultative voice in everything connected with the schools. In order to supply these schools with the requisite materials and teaching appliances at as cheap a rate as possible the Government undertakes to supply all such articles at wholesale prices.

At the end of each year examinations are held to test the fitness of the pupils for passing from the elementary school to the practical school, and from the latter to the improvement school. Promotions in classes are within the province of the teacher. Each school must have its separate premises and a residence for the master.

The school fee is three francs a year for each pupil for the day schools, but this payment may be raised to twice the amount, diminished, or even suppressed by the parish. The commission of schools sees to the general service, the supply of firing, apparatus, and furniture, and takes care that the master duly fulfils all the terms of his contract. Each school commission has a special fund for the school composed: 1, of legacies and donations; 2, of the contributions required from each new resident in the town, and from every woman brought into the place by marriage; 3, from the wedding donation, of five francs at the least, which each new married couple must contribute to the school fund. The curators are authorized to open a voluntary subscription every year. The canton pays the salary and retiring pension of the masters, as well as the charges fixed by law. It may make a grant for building new school houses or making necessary repairs. The cantonal council has at its disposal, for extraordinary assistance, a vote of 35,080 fr.

Secondary Schools.

These schools are established for boys and girls who, on leaving the primary schools, require further instruction. Their

object is to confirm the pupils in the knowledge acquired at the primary schools, and by developing the instruction within the limits of the programmes of the latter to enable some of them to enter the higher schools. Secondary schools may be established wherever there are suitable premises, a sufficient assured income, and 15 pupils at the least. If, for several consecutive years, the number of pupils falls to eight or under, it may be suppressed by the cantonal council.

The subjects taught are religion and morals, the German and French languages, arithmetic, geometry with practical exercises, history, geography, and the constitutional system of Switzerland, the elements of physics, with their application to agriculture and manufactures, singing, drawing, caligraphy, gymnastics, and the use of arms. A professor cannot be called upon to give more than 23 hours' lessons per week, gymnastics not included. The duration of the secondary studies is three years; but each year's course is complete in itself. The religious instruction is given by a clergyman. Girls may at the same time pursue the occupations adapted to their sex. When the number of pupils in any class exceeds 35 an assistant professor must be engaged, and a second when the number exceeds 50.

Each secondary school has its own special fund. The expenses are covered:—1, by a grant from the canton, which is 1,050 francs, or more if the school has above 50 pupils in each class; 2, by school fees and fines for non-attendance; the payment must never exceed 24 fr. a year, of which 8 fr. go to the professor; one pupil in eight is admitted gratuitously for the benefit of the poor; 3, by the interest of the invested capital of the school; 4, by voluntary contributions from parishes and private individuals; 5, by contributions from the parishes, which meet the deficits when any occur; the surplus is paid into the school reserve fund.

The University of Zürich.

The object of the university is:—1, to give a superior scientific education; 2, to contribute to the progress of science. It is divided into four faculties; viz., the faculty of *theology;* the faculty of *political sciences;* the faculty of *medicine;* and the faculty of *philosophy*, the instruction in which comprises the philosophical, philological, and historical sciences, and the mathematical, physical, and chemical sciences. Due regard is paid to the requirements of the present day and to the wants of the country.

The faculty of theology has five chairs; that of political science has no chair properly so called; that of medicine has six; and the faculty of philosophy, including the courses which belong to the polytechnic school, has 14. There are titular professors and assistant professors. The courses of the ordinary professors occupy in general 10 or 12 hours per week, and of the extraordinary professors four or six hours.

The ordinary professors have a salary ranging from 2,500 fr. to 4,000 fr. a year; the extraordinary professors receive from

1,000 fr. to 2,000 fr. They have also a certain share of the university and examination fees. The assistant professors are paid 5 fr. an hour if employed less than four hours per week, and 4 fr. only if more. Besides this the Council of Education has at its disposal 8,000 fr. for grants to assistant professors or other deserving persons.

After the examinations a doctor's diploma is granted to successful candidates. The young men of the canton must produce a certificate of maturity from a gymnasium before they can be admitted to the courses. On entering, each student pays a matriculation fee of 12 fr. and 6 fr. for the maintenance of the collections. He is obliged to pay the fee charged for each course of lecture which he attends, and this money, after a deduction of two per cent., is paid to the titular or assistant professor who gives the lectures.

The deans and professors form the academical senate which elects its own rector for two years. The rector, the ex-rector, and the deans form a committee of management and are necessarily consulted by the Council of Education on all matters touching the university.

Cantonal Schools.

These schools give a degree of instruction one step inferior to that of the university. There is one in each of the principal cantons, and they are divided into two parts according to the nature of the instruction; viz., the Gymnasium and the Trade school (*Gewerbe Schule*).

The subjects taught in the lower gymnasium are: religion, the German, Latin, Greek, and French languages, general and national history, geography, physics, mathematics, including arithmetic, free-hand drawing, caligraphy, singing, gymnastics, and military exercises. The annual payment is 30 fr. The subjects taught in the upper gymnasium are: religion, the German, Latin, Greek, Hebrew, and French languages, general and national history, mathematics, natural history, philosophy, singing, gymnastic and military exercises. The fee is 24 fr. per half-year.

The pupils who have passed through all the classes of the gymnasium may present themselves at the examination of maturity, and a certificate there obtained renders them admissible to the university. In the gymnasium the whole curriculum is compulsory.

The trade school is intended for young men who wish to become manufacturers or tradesmen, and likewise to prepare pupils for the higher technical and commercial schools. It is divided into the *lower* and the *higher* school.

The subjects taught in the lower trade school are: religion, the German and French languages, general and national history, geography, natural history, physics, mathematics, pure arithmetic, geometrical drawing, free-hand drawing, caligraphy, singing, gymnastic and military exercises. The fee is 30 fr. a year.

In the upper trade school the following subjects are taught in three specialities (*mechanics*, *chemistry*, and *commerce*); viz., religion, the German, French, English, and Italian languages, general and national history, geography, theoretical mathematics, applied mathematics, and mechanical technology (weaving, spinning, paper-making, machines, &c.), algebra, trigonometry and analytical geometry, mechanics, descriptive and technical geometry, shadows and perspective, geometrical and technical drawing, commercial arithmetic, commerce, banking, political economy, the use of bills of exchange, the legislation of different countries, book-keeping, the knowledge of merchandise, commercial geography and statistics, natural history (botany, zoology, mineralogy), physics and chemistry, chemical manipulations and technology, commercial relations, free-hand drawing, calligraphy, singing, gymnastic and military exercises. This higher section requires two years and a half of study. The courses are compulsory, those of gymnastics and military exercises excepted. The fee is 30 fr. per half year, and 30 fr. additional for the pupils who take part in chemical manipulations. Free auditors pay 5 fr. for a course of one hour per week during a half year.

The payment of the masters is calculated at the rate of 100 fr., 150 fr., or at the utmost 170 fr. per annum, for a weekly course of one hour. One half the sum paid by the pupils goes to the treasury of the school, the other half is divided among the masters and the fees paid by free auditors belong entirely to the latter. The regular masters are entitled to the denomination of *Oberlehrer;* the title of *Professor* is sometimes conferred as an exceptional distinction. The masters meet in council to discuss matters relative to their teaching, under the direction of a rector selected from among them by the cantonal council.

Veterinary School.

In this school the complete course of studies requires three years. The curriculum comprises: physics, chemistry, botany, zoology; comparative anatomy, the use of the microscope, surgical and pathological anatomy; physiology; knowledge of external forms, dietetics; rearing and training of animals; the art of riding; pharmacy and the knowledge of recipes; pathology and therapeutics, the treatment of surgical diseases, and of mares, cows, &c. when dropping their young; shoeing; the laws and police regulations relating to animals; clinics at the veterinary hospital, and abroad. To this establishment are annexed an hospital for animals, dissecting-room, a forge for shoeing, and the necessary collections.

To be admitted to the courses, a young man must enter his name either as an auditor or a pupil. The pupils are bound to follow the courses in the order prescribed. They must be at least 16 years of age, and pass an examination to prove that they possess the instruction given in the secondary schools. The pupils pay an entrance fee of 5 fr. and 30 fr. per quarter; one half of this money is paid into the school treasury, the other

half is divided among the professors. There are two principal professors; the one, who has the management of the hospital and teaches pathology and therapeutics, receives 2,000 fr., with a residence and garden; the other, who teaches anatomy and physiology, receives a salary of 2,400 fr.

The director, who is generally one of the principal professors, is chosen by the Council of Education.

A sum of 3,500 fr. is allowed by the Government to pay the assistants, and the clinical assistant has a special allowance of 1,000 fr., with lodgings in the establishment; in addition, a sum of 2,400 fr. is voted for other expenses and for increasing the collections. To cover these credits a sum of 6,000 fr. is taken from the proceeds of the stamp duties on cattle; the deficiency is supplied from the cantonal treasury.

Normal School for Teachers.

This school is intended to train teachers for the primary schools. Candidates for admission to the normal school must be 15 years of age, of good health, and free from all personal defects which might render them unfit for the service; they must also be of good moral character, and possessed of the instruction, expected from those who have passed three years in a secondary school, in biblical history, the French and German languages, arithmetic and geometry, history and geography, physics, singing, drawing, and caligraphy. The admission is at first only provisional, and is not made definite till after three months' probation.

The number of pupils admitted yearly is determined by the Council of Education, but must never exceed 100. The instruction is gratuitous. The studies extend over four years, but in the middle of the third year the courses should be terminated. The last six months are devoted to repetitions and exercises. The vacations must not exceed eight weeks yearly. The subjects taught are: religion and morals, the art of teaching, the German and French languages, mathematics, history, geography, physics, singing, the violin and piano, caligraphy, drawing, gymnastic and military exercises, and the elements of agriculture.

To the normal school is attached a boarding house, in which natives of the canton pay 240 fr. a year at the most, and foreigners 400 fr.; for this sum they have board, lodging, washing, and the attendance of a physician. A sum of 9,000 fr. is given in scholarships to promising students with narrow means; but no one individual can receive more than 300 fr. per annum.

The teaching staff consists of a director, who, besides, his functions in that capacity, keeps class for 12 or 13 hours per week, of his deputy, and the necessary number of professors. The director has a salary ranging from 1,800 fr. to 2,500 fr., besides lodging, board, firing, and lighting for himself and family. For the professors a sum of 16,000 fr. is allotted annually, to be divided amongst them in proportion to the number of hours' lessons they give per week. The director is appointed by the Central Council, at the instance of the Council of Education, and

the professors by the Council of Education. For the library, the collections, and the gymnastic and military exercises, a sum of 1,500 fr. is granted.

Agricultural School.

With a view to train agriculturists acquainted, equally both with theory and practice, the canton of Zürich has founded a school of agriculture. This establishment is placed under the immediate supervision of the agricultural commission, and is directly dependent on the Home Department. The pupils remain two years, and pay a yearly sum not exceeding 300 fr. The director has a salary of from 2,000 to 2,400 fr., and the professors receive from 1,000 to 1,400 fr.

In summer, the studies and work are distributed as follows :— From half-past four to half-past six, prayers, lesson, and explanation of the order of the day ; from half-past six to eleven, work in the fields ; from eleven till noon, lesson ; from noon till one, dinner and recreation ; from one to five work ; from five to seven, lesson or private study ; from seven to nine, supper and newspapers ; from nine to half-past, prayers. In winter, the pupils do not rise till six. There are, therefore, in summer, eight hours manual labour and five hours lessons daily ; in winter only six hours manual labour and five hours lessons.

In the canton of Zürich all pupils and professors of establishments of superior instruction have the free use of the cantonal library, for which the canton makes an annual grant of 5,000 fr. For the proper keeping and augmentation of the collections, philosophical instruments, and botanical garden, there is made an annual grant of 14,000 fr. In addition a yearly credit of 12,000 fr. is opened for the benefit of talented and well-conducted young men of limited means.

Establishments not included in the general educational system of the canton, and founded by corporations or towns, as well as those founded by private persons, which accept public aid, and are also subject to the approbation of the Council of Education, both for their mode of organization and for the choice of professors, and remain under its supervision.

Private educational establishments are subjected to the following regulations only :—A special authorization from the Council of Education is necessary, after due examination of the plans and arrangements, for every such institution including refuges for deserted children, Sunday schools, infant asylums, &c. Private establishments for primary instruction are bound to give an education at least equal to that of the public primary schools. They are subject to inspection by the Council of Education or its delegates. In case of any abuses arising in a private school, the Council of Education can order it to be closed. The cantonal council may grant aid to private schools, provided they satisfy a real want, and especially if they have in view the improvement of pupils leaving the primary schools ; in this case a special credit is opened for them.

Polytechnic School.

This excellent institution was founded in virtue of a law passed by the Federal Council in February 1854, on the basis recommended by a commission of its own members appointed to inquire into the subject. The preliminary articles of the law state that the object of the proposed polytechnic school is to give theoretical and practical instruction :—1, in architecture and the building arts generally; 2, in the construction of bridges, railways, and hydraulic works; 3, in mechanics, as applied to manufactures of all kinds; 4, in the theory and practice of chemistry, especially in its industrial applications; 5, in silviculture or forestry; 6, in philosophy and political economy, as well as in modern languages, mathematics, the natural sciences, political and artistic history, Swiss public law and political economy. It was decided that the Swiss Confederation should grant a early sum of 150,000 fr. (since increased to 250,000 fr.) for the maintenance of the school. All young men who had completed their seventeenth year, whether Swiss or foreigners, were to be admissible as pupils, provided they possessed the requisite elementary instruction; and for the benefit of such as were not sufficiently advanced, a preparatory school was to be annexed to the establishment.

The teachers are divided into three classes, professors, assistant professors, and supernumerary professors (*agrégés*); the two former were to have fixed salaris, while the last were to be paid in proportion to the number of lessons they gave.

The law invests the Federal Council with the supreme authority over the school, the immediate management being confided to a council composed of a president and three members, with a deputy for each of these last. All these are elected by the Federal Council for five years, and must be Swiss citizens. No two persons so nearly related as cousin-germans can sit in the council at the same time. Three members to form a quorum. The president has a salary of 4,500 francs, and the other members of the council receive an indemnity for every day's attendance, and also their travelling expenses. The council elects its own secretary for five years, and he has a salary not exceeding 3,000 francs. The professors are all definitively appointed by the Federal Council on the recommendation of the school council. Every professor incapacitated by old age or bad health is entitled to a retiring pension. All the accounts of the school are to be yearly submitted for approbation to the Federal Council.

The law further enacted that the seat of the school should be at Zürich, which city engaged to supply, at its own expense, all the necessary buildings, and to allow the professors and pupils the use of the numerous museums and collections; also to contribute a sum of 16,000 fr. a year towards the general expenses.

The school was established in conformity with the provisions of this law, as will be seen by the following abstract of the existing regulations :—

Divisions of the School.

The Federal Polytechnic School comprises six divisions: the 1st, a school for architecture and the building arts; the 2nd, for civil engineering; the 3rd, for mechanicians; the 4th, for chemists; the 5th, for foresters; while the 6th is a superior scientific school of the natural and mathematical sciences, literature, and the moral and political sciences. The courses of the first five divisions are annual, those of the sixth are half-yearly. The whole instruction is completed in three years for the first three divisions, and in two years for the fourth and fifth. The first and second years of the architectural division are sufficient for ordinary builders, but those pupils who wish to obtain the diploma of architect must go through the three years teaching.

The division of civil engineering gives theoretical and practical instruction in all that concerns bridges, roads, railways, hydraulic constructions, and public works of all kinds. The first and second years are devoted to matters with which every engineer must be conversant; the third is especially employed in higher technical teaching.

The mechanical division teaches the theory and practice of constructing machines, and also their application to the different processes of manufacture. The instruction of the first and second years treats of matters essential to every mechanician. In the third year the pupil completes his theoretical study of mechanics, and at the same time acquires the special technological knowledge necessary for the managers of large manufacturing establishments.

The chemical division fits the pupils to become either manufacturing or pharmaceutical chemists. The first year is devoted to the acquirement of the knowledge indispensable to every profession depending on chemistry. The courses of the second year are sub-divided into two special heads: — 1. Chemistry applied to industry; 2. Pharmaceutical chemistry. (The students who follow the latter branch must know enough Latin to be able to translate passages from a pharmacopœia written in that language.)

The division for foresters is intended to train pupils to become managers of forests, and they are exercised in the practice of their profession.

The sixth division gives purely scientific instruction of a high order, with special reference to the application of the sciences to industry; it also embraces the study of the literature of the more important living languages, of political and artistic history, political economy, public law, and those portions of civil and administrative law which are necessary for the pupils of the first five divisions.

The instruction is given through the medium of the German, French, or Italian language, at the option of the professors.

Admission of Pupils.

The youths who study at the Polytechnic School are divided into regular pupils and free auditors. Those who wish to make the complete course of study in the first five divisions, in order to obtain a diploma, must enter themselves as regular pupils,

whilst those who only want to attend certain lectures for some particular purpose may become free auditors.

Every candidate for admission as a regular pupil must present himself in person to the director of the school, giving his name, native place, the address of his parents (or guardians), and his own address at Zürich. He must also produce certificates showing that he is 17 years of age, and of good moral character. He has then to undergo an examination for the purpose of ascertaining whether he is sufficiently instructed to follow the courses beneficially.

The school fee for regular pupils (there are no boarders) is 100 francs for the year. (Previously to 1864 the fee was only 50 francs.) If he attends the laboratories and workshops he will have to pay a further small sum.

Persons who wish to enter as free auditors must likewise produce certificates of age and character, and pay a fee for every course they attend, the amount of which is fixed by the professors.

Discipline.

The pupils of the Polytechnic School are, like all the inhabitants of the canton, subject to the general laws and ordinances of the State, and are amenable to the ordinary tribunals for all offences or crimes they may commit. The school authorities have the right to punish all infractions of internal discipline, such as neglecting study, immoral conduct, or disobedience. The penalties usually inflicted are—1, reprimand before the director or the general conference of professors; 2, reprimand before the president of council of the school, or before the council itself; 3, menace of expulsion; 4, and lastly, expulsion. In case of an expulsion, the offender's name is posted in one of the halls of the school, and information of the fact is given to the Zürich police, and to the authorities of the town to which the party belongs.

Diplomas.

Diplomas are granted to those pupils who have followed all the courses of any one of the first five divisions, provided they pass the examinations satisfactorily, and their names are published in the official gazette of the canton.

Examinations.

At the end of the academic year there is a public examination for each of the first five divisions, after which there is an exhibition of the drawings, plans, and other performances of the pupils. The result of the examinations enables the professors to decide whether the pupils are sufficiently advanced to pass on to the next class. A pupil cannot remain more than two years in the same class; if he be then incompetent, he must leave the division. The same rule is applied to the free auditors.

The latter can also demand certificates of regular attendance at the lectures, and of the extent to which they have profited by them.

Programmes.

The school opens in the first fortnight of October, and the winter term ends in the week before Easter; the summer term commences a fortnight after Easter, and ends in the middle of August.

During the year 1863–64 the various subjects of study in all the divisions were distributed as follows:—

Winter Term. Subjects taught.	Hours' Lessons per Week.	Summer Term. Subjects taught.	Hours' Lessons per Week.
PREPARATORY DIVISION.			
Elementary mathematics, algebra, solid geometry, trigonometry	12	Elementary mathematics (continued), analytical geometry, elementary mechanics	12
Experimental physics	4	Experimental physics	4
German (for pupils not knowing it)	8	Elements of descriptive geometry	2
French	3	German (if necessarry)	8
Elements of descriptive geometry	2	French	3
		Practical geometry	3 to 4
		Technical drawing	6
FIRST DIVISION.—BUILDERS.			
First Year.			
Differential and integral calculus	5	Differential and integral calculus	5
Descriptive geometry	4	*Coupe des pierres*	4
History of ancient art and archæology	4	Technological chemistry, materials	1
Construction	4	Construction	3
Projects of building details	6	Construction-drawing	8
Architectural drawing	4	History of mediæval architecture	4
Landscape drawing (not compulsory)	4	Architectural drawing	4
Modelling (not compulsory)	9	Drawing of ornament	4
Experimental chemistry, for pupils not knowing it	5	Landscape drawing (not compulsory)	4
		Modelling (not compulsory)	9
Second Year.			
History of architecture	4	Mechanics	3
Theory of shadows, perspective	3	Perspective	3
Mechanics	3	History of the building art	4
Petrography	3	Roads and hydraulic constructions	2
Roads and hydraulic constructions	3	Exercises in architectural composition	4
Exercises in architectural composition	4	Drawing for construction	4
Exercises in building	6	Drawing of the figure	9
Drawing of ornament	4	(Modelling and landscape drawing as in the first year.)	
Drawing of the figure	9		
Forms of roads from the Romans to the Revival	2		

Third Year.

Winter Term. Subjects taught.	Hours' Lessons per Week.	Summer Term. Subjects taught.	Hours' Lessons per Week.
History of architecture -	4	History of architecture -	4
Technical geology, exercises in architectural composition	4	Composition exercises -	4
Exercises in building - -	6	Drawing of buildings - -	4
Civil and administrative law	2	Civil and administrative law	1
Drawing of ornaments - -	4	Modelling and landscape as in the first year - -	2
Progress in road-making from the time of the Romans to the Revival - - - -	2	Plans and general constructions - - - - -	1

SECOND DIVISION.—CIVIL ENGINEERS.

First Year.

Differential and integral calculus (1st part) - -	6	Differential and integral calculus, analytical geometry of three dimensions - -	6
Repetitions, the pupils attending in groups - - -	3	Repetitions: pupils attending in groups - - - -	7
Differential and integral calculus, by another professor	6	Differential and integral calculus, by another professor	4
Repetitions - - - -	1	Repetitions - - -	1
Descriptive geometry - -	4	*Coupe des pierres* - -	4
Repetitions (in groups of pupils) - - - -	2	Repetitions (of pupils in groups) - - - -	2
Topography - - -	3	Technological chemistry of	
Constructions (course of) -	4	building materials - -	1
Exercises in ditto - -	4	Constructions (course of) -	3
Drawing of machines - -	4	Drawing for construction -	
Drawing of plans - - -	3	Drawing of machines - -	
Petrography - - -	3	Drawing of plans - -	
Experimental chemistry (for beginners) and repetitions -	6	Land-surveying - - -	
		Topography - - -	

Second Year.

Differential and integral calculus (2nd part) - -	2	Differential and integral calculus (continued) - -	
The same in French - -	2	The same in French - -	
Experimental physics, with technical applications (1st part) - - - - -	4	Perspective - - - Theory of machines - - Astronomy (1st part) continued - - - -	
Repetitions - - - - -	1		
Technical mechanics - -	6	Exercises at the observatory	
Repetitions (in groups) -	3	(in groups of pupils) -	
Shadows and perspective -	3	Experimental physics, with	
Astronomy (1st part) - -	3	technical applications (2nd	
Technical geology - -	2	part) - - - -	
Embankments, foundations, bridges, stone bridges, and tunnels - - - - -	3	Repetitions - - - - Wooden bridges, roads -	
Repetitions (in groups) -	3 to 4	Repetitions (in groups) -	1
Graphic statics - -	2	Exercises in constructions -	
Exercises in construction -	6	Mapping - - - -	
Mapping - - - - -	3		

Third Year.

Winter Term. Subjects taught.	Hours' Lessons per Week.	Summer Term. Subjects taught.	Hours' Lessons per Week.
Theory of machines (continued), steam-engines	6	Hydraulic constructions	4
Astronomy (2nd part)	3	Repetitions	1 to 2
Land surveying	3	Astronomy, 2nd part (continued)	3
Iron bridges, roads, railways	4	Land surveying	3
Repetitions (in groups)	3 to 4	Exercises in construction	6
Exercises in construction	6	Administrative law	2
Administrative law	1	Mapping	3
Mapping	3	Exercises at the observatory (in groups)	12

THIRD DIVISION.—MECHANICIANS.

First Year.

Differential and integral calculus (1st part)	6	Differential and integral calculus, analytical geometry of three dimensions	6
Repetitions (in groups)	3	Repetitions of both (in groups)	7
Differential and integral calculus (in French)	6	Differential and integral calculus, and analytical geometry (in French)	4
Repetitions	1	Repetitions	1
Descriptive geometry	4	*Coupe des pierres*	4
Repetitions (in groups)	2	Repetitions	2
Analytical geometry, with exercises	3	Technological mechanics (1st part)	6
Drawing of machines	8	Repetitions (in groups)	3
Mechanical technology, 1st part (spinning, weaving, paper-making)	3	Technological chemistry of building materials	1
Experimental chemistry (for beginners)	6	Metallurgy	2
		Machine drawing	5 to 6
		Civil constructions and drawing exercises	4 to 5

Second Year.

Differential and integral calculus (2nd part)	2	Differential and integral calculus, 2nd part (continued)	2
The same (in French)	2	The same in French	2
Experimental physics, with technical applications	4	Theory of machines (1st part)	6
Repetitions	1	Experimental physics (2nd part), with practical applications	4
Technical mechanics (continued)	6	Repetitions	1
Repetition (in groups)	3	Course of construction of machines, 1st part (continued)	4
Course of construction of machines (1st part)	6	Construction of machines	12
Mechanical technology 2nd part, (working in wood and iron)	3		
Construction of machines	8		

Third Year.

Winter Term. Subjects taught.	Hours' Lessons per Week.	Summer Term. Subjects taught.	Hours' Lessons per Week.
Theory of machines - -	6	Theory of machines 2nd part, (locomotives, steamboats) - - - -	3
Course of construction of machines (2nd part) -	6	Course of construction of machines (2nd part) -	6
Exercises in construction of machines - - - -	8	Exercises in construction of machines - - -	12
Iron bridges, roads, railways	8		

FOURTH DIVISION.—CHEMISTS.

First Year.

Select chapters of mineral chemistry - - -	2	Organic chemistry - -	6
Experimental physics as applicable to chemistry -	4	Analytical chemistry - -	3
Repetitions - - - -	1	Metallurgy - - - -	2
Chemical technology, chemical products - - -	3	† Chemical technology of building materials - -	1
Ditto,* glass and ceramics -	1	Exercises in the technical laboratory - - -	12
Repetitions and conversations	1	General zoology and anthropology - - - -	3
Description of machines -	5	* Elementary mineralogy -	4
Mineralogy and repetitions -	3	† Repetitions of mineralogy -	2
Principles of general botany -	6	Technical drawing - -	4
† Zoology - - - -	4	* Special botany of the officinal plants of most importance to medicine and industry - - - -	3
* Technical drawing, practical and analytical - -	9		
** Experimental chemistry, with a sketch of organic compounds - - -	6		

Second Year.

* Chemical technology (bleaching, dyeing, printing) -	3	Lighting and warming -	2
* Repetitions and conversations - - - - -	1	Exercises in the technical laboratory - - -	12
* Mechanical technology, 1st part (spinning and weaving)	3	Chemical technology of the victualling trades - -	2
* Applied crystallography -	3	Exercises in the analytical laboratory - - -	12
* Technical geology - -	2	Exercises in assaying minerals	3
Technical law - - -	12	* Materia medica - -	3
* Technical drawing - -	4		
† Pharmaceutical chemistry -	3		
† Pharmaceutical botany -	3		

The courses marked with * are compulsory only on the pupils of the technical division; those marked with †, for the students of the pharmaceutic division; those with ** are not compulsory on pupils of the first year, but they may attend them if they choose.

During the summer term lessons are given in organic chemistry, analytical chemistry, * metallurgy, chemical technology of building materials, zoology, special botany, heating and lighting, the assay of minerals, † materia medica, † the study of officinal plants. The courses marked by a † are compulsory only on the technical division; those with * on pharmaceutists only. Besides the compulsory hours, the pupils have access to the laboratories at other times.

Fifth Division.—Forest School.

First Year.

Winter Term. Subjects taught	Hours' Lessons per Week.	Summer Term. Subjects taught.	Hours' Lessons per Week.
Mathematics, so far as applicable to forestry	3	Forest entomology	2
Principles of general botany	3	Management of forests, including the theory of draining	3
Petrography	3	Economic botany	4
Topography	3	Topography	3
Drawing of plans	3	Drawing of plans	3
Encyclopædia of forest science	4	Land-surveying	3
Forest law (1st part)	1	Excursion in forests and practical work	3
Excursions and exercises in valuation	1 day.	Forest law	1
Experimental chemistry, organic combinations, and repetitions	6	Introduction to working of forests	1

Second Year.

Working of forests	5	Statics and forest statistics	2
Utilization of forests	3	Culture of forests	4
Forest administration	1	Forest economy of the State	3
Agronomy and climatology	3	Roads and hydraulic constructions	2
Technical geology	2	Forest law	1
Roads and hydraulic constructions	3	Agricultural chemistry	2
Forest law (2nd part)	1	Excursions in forests, and practical work	2
Excursions and exercises in valuation	1		

Sixth Division.—I. *Natural Sciences.*

Experimental physics	4	General chemistry	2
Repetitions (in German)	1	Experimental physics	4
Ditto (in French)	2	Repetitions (in German)	1
Magnetism, electricity, galvanism	3	Ditto (in French)	2
Experimental physics, bearing on chemistry	4	Physics of the earth	3
Repetitions	4	Experimental physics, 2nd part (optics, magnetism, electricity)	4
General geology	4	Repetitions	1
Geology of the Jura	1	Mathematical theory of heat	4
Palæontological geology of the sedimentary strata	5	Volcanos	3
Pharmaceutical botany	3	Geology (volcanos excepted)	3
Fossil botany	3	Geology of the Jura	1
Fossil insects	2	Special botany	6
General botany	5	Cryptogamia	2
Microscopic exercises	4	Microscopic exercises	6
Zoology	6	Organic chemistry	6
Experimental chemistry	5	Analytical chemistry	2
Repetitions	1	Practical chemistry	12
Analytical practice	9	Principles of mineral chemistry	4
Pharmaceutical chemistry	3	Repetitions	1
History of chemistry	2	Comparison of the new chemical theories	1

II. *Mathematical Sciences.*

Winter Term. Subjects taught.	Hours' Lessons per Week.	Summer Term. Subjects taught.	Hours' Lessons per Week.
Definite integrals - - -	2	Select chapters of the integral calculus on the application of imaginary values	5
Differential equations, with applications - - -	2	On the application to geometry - - - -	2
Higher algebra (theory of equations) - - - -	2	Calculus of variations - -	2
Theory of the functions of a complex variable - -	2	Analytical geometry of straight lines and plane curves - - - -	2
Elements of the theory of numbers - - - - -	3	Elements of mathematical astronomy and geography	2
Introduction to the differential and integral calculus -	4	Geometry of position - -	3
Analytical geometry, especially of plane curved lines	2	Exercises in construction -	2
General introduction to the teaching of mathematics and to the complete knowledge of the mathematical system - - - - -	2	Introduction to the infinitesimal calculus and to the calculation of probabilities	2
Numerical approximation -	2	Mathematical exercises -	2
Exercises in the execution of great astronomical calculations - - - - -	4	Select chapters of the new geography - - -	2
Elements of astronomy and mathematical geography -	2	Application of the differential and integral calculus to mechanics - - -	2

III. *Languages and Literature.*

History of modern German poetry - - - - -	3	History of modern German poetry from J. P. Richter to the present day - -	3
Summary of the history of literature in Europe during the 19th century - -	2	Shakespeare's plays - -	3
General history of the French language and literature from their origin to the 17th century - - -	2	General history of French literature, the *Siècle de Louis XIV.* - - - -	2
Exercises in the French language - - - - -	2	Exercises, readings, and explanations of Boileau's *Art poétique* and Molière's *Bourgeois gentilhomme* -	2
History of English literature to the time of Elizabeth -	2	History of English literature from the time of Elizabeth	2
Shakespeare's sonnets translated and elucidated - -	1	Shakespeare's *Hamlet* translated and commented -	3
English exercises on grammar	2 to 3	Literature of Galileo's school	2
Il genio et gli scritti di Galileo Galilei - - - -	2	Exercizi di lingua e lettura -	3
Exercizii di lingua, e lettura, tradizioni e composizioni -	4	Mythology of Germany -	3
		The *Nibelungen Lied* - -	2
		The *Edda* - - - -	2

IV. *Historical, Political, and Military Sciences.*

Winter Term. Subjects taught.	Hours' Lessons per Week.	Summer Term. Subjects taught.	Hours' Lessons per Week.
Sketch of ancient history -	2	Organization of the Swiss artillery (cannon, caissons, waggons, ammunition) *gratis* - - - -	2 to 3
History of the times of Frederick the Great and of the French Revolution (1740–1799) - - - - -	3	History of civilization and manners before the Christian era, especially among the Greeks and Romans -	2
Ancient history, artistic and archæological - - -	4	History of the 19th century, 1st part (1800–1830) -	3
Dürer and Holbein, their contemporaries and predecessors - - - - -	2	Political development and civilization in Switzerland from the conclusion of the perpetual treaty of the primitive cantons to the formation of the confederation of the 13 cantons (1315–1513) - - -	2
Political and intellectual development of Switzerland from the remotest times to the Reformation - -	2	Swiss reformers of the 18th century - - - -	1
The precursors of the Swiss Revolution - - -	2	Mediæval arts - - -	4
Explanation of the sculptures in the Archæological Museum - - - - -	1	Arts in the 19th century -	2
Mythology and anthology -	4	History of art - - -	1
Administrative law in Switzerland - - - - -	4	Applications of economic sciences, distributive and fiscal laws - - -	2
Federal law of the United States of America - -	3	Administrative laws of the Swiss cantons - - -	3
Political economy - -	2	Civil law - - - -	1
Elementary course of statistics	2	Forest law - - - -	2
Commercial law - - -	3	Commercial law - - -	3
Civil and administrative law -	1		
Forest law - - - - -	1		

V. *Fine Arts.*

Perspective - - - -	1	Landscape in water-colours, sepia, pencil, and charcoal	4
Landscape in water-colours, sepia, and pencil - -	4	Drawing of the figure from copies and models, in pencil, crayons, or Indian ink	9
Drawing of the figure from copies and models, in pencil, crayons, and Indian ink	9	Drawing of ornaments in Indian ink, chalk, and colours - - - -	4
Exercises in modelling - -	9	Modelling in plaster and clay; preparation of stucco, mosaics - - - -	9
Stenography on Arendt's system (a course of about six weeks) - - - - -	2		

In the year 1863–64, the total number of regular pupils and free auditors was 510, divided among the different courses as follows :—

Number of the Division.	Specialty of the Courses.	Length of the Studies.	Number of Pupils of each Year.	Number of Regular Pupils.	Number of Free Auditors.	Total Number in each Specialty.
	Preparatory course.	- -	- -	40	30	70
1st Division	Builders -	1st year 2nd „ - 3rd „ -	23 7 5	25	10	35
2nd Division	Engineers -	1st „ - 2nd „ - 3rd „ -	51 45 44	57	83	140
3rd Division	Mechanicians	1st „ - 2nd „ - 3rd „ -	71 41 35	62	85	147
4th Division	Chemists -	1st „ - 2nd „ -	29 22	29	22	51
5th Division	Foresters -	1st „ - 2nd „ -	10 22	18	4	22
6th Division	- - -	- -	- -	34	11	45
	Totals	- -	-	265	245	510

This summary shows that there is considerable inequality in the distribution of the regular pupils and the free auditors among the different courses, but it is also evident that, in the division of builders, the third year's courses are less followed than those of the first two years. This difference is doubtless owing to the fact that this course is more especially attended by the pupils who aspire to become architects for public buildings, whilst the others suffice for private undertakings.

There is also to be remarked an analogous and considerable difference in the division for mechanicians, who, from 71 pupils in the first year, fall to 25 in the third. Perhaps by rendering the teaching more simple, it might be possible to retain a greater number of pupils for the whole course of study.

From what precedes it is evident that the Polytechnic Institute of Zürich is at once a school of pure science and a school of application. In the first five divisions, which are altogether technical, the theoretical studies are conducted *pari passu* with the practical or studies of application. In the sixth division, on the contrary, where free teaching embraces numerous and diverse branches of studies purely scientific, these studies may receive much greater development, which is all the more appropriate, as that division is naturally destined for young men who intend to cultivate the sciences, either from a natural predilection for them or with the view of becoming professors.

Since this last division offers those pupils who desire it all the means of extending their theoretical studies without restriction as to time, it might perhaps be possible to slightly lower the

mathematical teaching in the special divisions of builders, engineers, and mechanicians. These may be taught, by the aid of the elements of geometry, algebra, and the infinitesimal analysis; all that the students require to know of mechanics, the resistance of materials, and the stability of buildings, they can learn without having recourse to the higher mathematical analysis. Thus to bring science, by simpler methods, within the reach of all the pupils, without in any way weakening the force of the demonstrations, is to facilitate its diffusion, and make it accessible to a greater number of minds without descending to a lower level of instruction.

The Polytechnic School contains numerous collections of all kinds, drawings for teaching, models of machines well executed and to scale, a rich library; and, as the buildings in progress shall be successively finished, they will be filled with the rich collections of zoology, botany, mineralogy, and paleontology, which the city possesses. The budget of the school has been augmented, and for the year 1864 it amounted to the sum of 340,000 francs. The school fee, of which the professors receive two-thirds, and one-third only goes into the school treasury, was originally only 30 francs, but has been raised to 100 francs for both Swiss and foreigners; it is expected to produce at least 64,000 francs. The maximum number of pupils the school can receive is 600, and in 1863-64 the actual attendance was 510, as seen by the preceding table. The laboratories are so judiciously arranged that they deserve special mention, because they may well serve as models for similar establishments. They are divided into two parts, one for analysis, the other for technical manipulations; each can accommodate 60 pupils simultaneously engaged in manipulations. The fee for the use of the laboratories is 4 francs per month, all apparatus and re-agents being supplied without further charge.

SPECIAL REPORT ON THE EDUCATIONAL ESTABLISHMENTS IN THE KINGDOM OF WURTEMBERG.

Primary Schools.

The laws which make instruction compulsory in the kingdom of Würtemberg are not of very ancient date. The first was passed on the 29th September 1836, and the second on the 6th November 1852. Their application encountered no difficulties, even in those parts of the country where circumstances seemed most unfavourable. Every village containing 30 houses must have a school, and no one master is allowed to teach more than 90 pupils. The supervision of these schools, as regards the teaching and moral training, the appointment of the masters, the erection and

repairs of the school-houses, the control over the normal school for masters, and over private schools, is entrusted to the consistory of the Reformed Church in parishes of that persuasion, and to the Catholic clergy in parishes where their religion prevails. In both cases the schools for the children of Jews are under the same authority as the Christian schools of the locality. Apprentice are bound to attend the Sunday schools till their 18th year.

Factory Schools.

In this kingdom education has become so much a part of the national habits that a law compelling the education of children employed in factories is scarcely necessary. The industrial establishments which employ children, and are situated in isolated positions, nearly all have schools attached to them, which are as well managed as those of the parishes.

Drawing Schools.

One of the most remarkable features in the primary schools of Würtemberg is the extraordinary attention paid to the teaching of drawing. The Department of Trade and Manufactures has persuaded the Ministry of Public Instruction and Worship to add classes for industrial drawing to all these schools, and the Ministry has had the wisdom to leave to that department the care of organizing and superintending their progress. They were founded, after the Universal Exhibition of 1851, to enable the manufacturers of the country to compete with France in the industrial arts. These schools were at first gratuitous, but experience proved that attendance was better secured by requiring a small payment, varying according to the means of parents, from half a florin to 12 florins a year.

The teachers are, as far as possible, chosen from among the workmen or masters of the chief industries of the place, who having been taught in the same schools have there acquired the requisite knowledge. But these workmen thus made teachers do not abandon their trades, and receive only an indemnity of about two florins per hour's lesson. They generally give three a week of two hours each, from 7 to 9 o'clock in the evening. At Geisslingen, for instance, there is a school where 180 scholars are taught by a master mason. In more than one parish the heads of establishments have so well appreciated the importance of this instruction that they themselves send their young workmen and apprentices to the schools. It has been remarked that artists of considerable talent have not succeeded so well as masters as mere artisans, which proves that there would not be so much difficulty as is supposed in expeditiously training teachers for this kind of schools.

The Department of Trade has adopted examples to be used in all these schools, of which the first series intended for beginners consists of lithographs, easy and few in number, merely

for practice to give freedom to the hand, while accustoming the pupil to guide it by the eye. The next step for the pupils is to draw from plaster models, graduated from the most simple figures to the finest casts from the antique, which are reserved for the principal schools. These models are supplied by an artist of Stuttgart, according to a tariff approved by the Department of Trade. They are delivered by him to the parish schools, which pay for them, but at the end of the year the Department pays back to the schools one-half of the sums so disbursed. Besides these models in relief the Department of Trade has formed a collection of the best publications on industrial art, from the most costly to the humblest albums of furniture, cabinet work, bronzes, &c. It distributes these works throughout the country, lending them to the masters of the schools for a certain period, usually one month. They must be returned in fair condition, and any damage suffered must be made good.

Every other year the schools send to Stuttgart a collection of their drawings of all kinds for exhibition, after which prizes are given to those which sent the finest productions. The masters themselves are invited to attend this exhibition and to control the awards made. From among the most skilful masters a certain number are chosen, who, during the vacation, or at other times, go round to the schools as occasional inspectors, and suggest improvements to the masters, sometimes even giving them private lessons.

Drawing also forms part of the instruction given in the normal school for primary teachers, so that they may be able thereafter to teach their pupils the first elements. A few of the pupils who have shown most skill and taste, are sent to the Superior Art School at Nüremberg.

Thus there have been established in the kingdom of Würtemberg more than 400 drawing schools, and this organization, which does not date back more than ten years, has already led to very decided improvements in the manufactures of the country.

It is satisfactory to know that the designers trained in these schools, if they evince any considerable degree of taste and invention, easily find occupation in their own country. The more distinguished among them are sometimes sent to France for improvement. Great emulation exists among the teachers and professors of drawing, and, besides the biennial exhibitions made by order of the Government, an association has been formed by the masters, which, aided by voluntary contributions, has raised a fund for the purpose of organizing regular exhibitions of all the pupils' drawings, and for awarding prizes.

Weaving School.

The Department of Trade and Manufactures has established a museum containing numerous collections of well-chosen models of machines, and of agricultural implements, as well as a fine technological collection of the various products of industry. But the most remarkable of its institutions is a weaving school, not intended to train apprentices, but to complete and develop,

by the theoretic teaching of weaving, the experience already acquired by intelligent workmen. For this purpose it selects from among weavers those who, besides their professional ability, have shown most aptitude and zeal in the drawing schools. For the use of these persons, not exceeding eight or ten in number, 25 different kinds of looms have been provided, as well as all the accessory apparatus for the preparation of the cards, &c. The men are instructed in all the principles of the art of weaving, as well for the decomposition as for the composition of new tissues. They make ready the looms and execute the new fabrics they have designed.

This instruction is given without taking the men from the practice of their trades, and they are made to cover their own expenses by working five or six hours a day. The goods they produce are bought by the manufacturers who supply the raw material. While thus learning the theory of weaving the young men are bound to study French and English, and to improve themselves in drawing. After two years' residence those who have most distinguished themselves are sent to France and to England, with part of their expenses paid, in order to work in manufactories, to study new processes, and to improve their taste. They afterwards return home to profit by what they have learned.

Middle Schools (*Mittel Schulen*).

This name is applied to all those establishments which give a degree of instruction more extensive than can be obtained in the primary schools, but inferior to that of the universities, such as the Protestant theological seminaries, the gymnasia, the lyceums, the Latin schools, the lower and higher practical schools, the technical schools for the building trades (open in winter only), the school for professors of gymnastics, and the model school of gymnastics at Stuttgart. These middle schools are entirely under the control of the Council of Studies (*Studienrath*), as to supervision, direction of studies, appointments of professors, examinations, &c., directly for those of the higher order, and through the medium of the local authorities for the others. The Council of Studies is moreover charged with the supervision of private schools giving the corresponding degree of instruction.

Seminaries.

There are four lower seminaries for youth between the ages of 14 and 18, and a higher seminary at Tübingen. The studies extend over four years. The State pays for 25 pupils. Each lower seminary has a principal, dean, two professors, two tutors, and a music master. In the higher seminary there are a principal, dean, and nine tutors; the students attend the lectures of the university.

Gymnasia.

There are seven gymnasia in Würtemberg, those of Stuttgart, Ulm, Heilbronn, Ellwangen, Esslingen, Rottweil, and Tübingen.

They give a superior scientific education and prepare for the universities. The Heilbronn gymnasium receives 40 boarders.

The lyceums of Ludwigsburg, Oehringen, and Ravensburg, are intermediate establishments between the gymnasia and the lower Latin schools, for youth between 14 and 16 years of age. In the Latin schools (*Latein Schulen*) boys leaving the primary schools are taught the dead languages till they have completed their 14th year.

The inferior practical schools (*Real Schulen*) are, as regards the age of the pupils and the position of the professors, parallel establishments to the Latin schools, but in them are taught what are called the *real* branches and the French language, to the exclusion of the dead languages. For boys above 14 there are higher practical schools at Stuttgart, Ulm, Heilbronn, Ludwigsburg, Esslingen, Reutlingen, Tübingen, Rottweil, and Hall, intended to prepare youths for the polytechnic school, or to give a more complete education to young men who mean to follow an industrial career.

The elementary schools, which are found in all large towns, prepare children from six to eight years of age for philological or *real* studies. Besides this, the young men, especially apprentices and workmen in the building trades, may receive during the winter season technical instruction for the building art, in the winter building schools (*Winterbaugewerbeschulen*), which were organized in 1845. For the teaching of gymnastics, which have formed part of the instruction given in primary and middle schools ever since 1845, a school for professors of the art has been established in connexion with the model gymnastic school of Stuttgart, which is attended by the pupils of the gymnasium.

Trade Schools (*Gewerbe Schulen*).

Under this designation there are in the kingdom of Würtemberg 101 Sunday and evening schools, in which drawing is the principal thing taught, though some of them give instruction in the elements of the sciences. The number of pupils attending these schools in the summer of 1863 was 7,979.

Improvement Schools (*Fortbildung Schulen*).

Since 1853 the Ministry has appointed a commission to organize and conduct schools of this kind, at present 84 in number, including the Sunday schools, and to provide them with the necessary appliances as well as competent drawing masters. The instruction received is the same as in the preceding, and it is given partly by professors of other establishments and partly by special professors.

University of Tübingen.

This university has seven faculties:—Protestant theology; Catholic theology; law; medicine; philosophy; political

economy; and sciences. There are also as accessories:—1, a library; 2, a Protestant seminary; 3, an institute of anatomy; 4, a physiological institute; 5, a botanical garden; 6, a chemical laboratory, with special divisions for physiological, pathological, agricultural, and technical chemistry; 7, a cabinet of surgical instruments; 8, medical, surgical, and obstetrical hospitals; 9, a collection of zoology and comparative anatomy; 10, a mineralogical and geological collection; 11, a cabinet of coins and antiquities; 12, a cabinet of physics; 13, an observatory and astronomical cabinet; 14, agricultural and forest collections; 15, a technological collection; 16, a philological seminary for professors; 17, a school of design; 18, a gallery of paintings; 19, a school of cavalry and the breeding stud; 20, a fencing school; 21, a gymnastic school; and 22, a swimming school.

In the university there are 75 professors, of whom 41 are ordinary, 9 extraordinary, and 19 assistants. In the winter term of 1862-63 there were 620 pupils, of whom 167 were foreigners. Besides the 136,000 florins which the school receives from the Government it has a revenue of its own amounting to about 30,000 florins.

Agricultural Schools.

The Agricultural and Forest Academy at Hohenheim was founded in 1818; the course of instruction lasts two years. This academy, which has considerable reputation, possesses a farm of 1,000 *morgen* attached to it. There are also an elementary school of agriculture, with three years' study, for 25 pupils, and a horticultural school for six pupils. The establishment has a director-professor, eight professors, and nine assistant professors. In 1862-63 the agricultural school had 121 pupils, of whom 82 were foreigners, and the forest school 33 pupils, two of them foreigners; in all 154 pupils.

There are also on the royal domains of Ellwangen, Ochsenhausen, and Kirchberg, three lower agricultural schools.

Veterinary School at Stuttgart.

The course of studies occupies two years. Natives of Würtemberg are taught and boarded gratuitously. Foreigners pay five florins for each half-yearly term. There are from 30 to 40 pupils.

Polytechnic School.

The Stuttgart Polytechnic School is organized something like the German universities, inasmuch as, while it trains pupils for various technical specialties of the public services and of manufactures, it does not absolutely determine what courses the pupils must follow to acquire the necessary instruction, but leaves them almost entirely to choose for themselves. The instruction is ad-

dressed at once to the young men who are preparing for those branches of the public services and of manufactures in which the application of physical science are required, and to those who wish to follow the career of public scientific instruction.

The course of studies comprises five years, two of which are preparatory for the mathematical, physical, and natural sciences; and the other three are devoted to the special branches of architecture, civil engineering, machine construction, and technical chemistry. The last-named branch is moreover divided into three courses according as the students intend to pursue the industries of chemical products, metallurgy, or pharmaceutical chemistry. There is also a commercial division requiring one year's study, corresponding with the second preparatory year.

The pupils are divided into regular pupils and free auditors. To be admitted as a regular pupil the candidate must be 16 years of age for the mathematical division, 15 for the commercial, and 18 for the technical divisions; must present a certificate of moral conduct; must undergo an examination to prove that he has the instruction necessary to follow the courses; and must produce an authorization from his parents or guardians. The instruction required is, for the mathematical division,—Algebra, as far as quadratic equations, and the use of logarithms; geometry, plain and solid; the elements of plane trigonometry; the elements of the French language; the habit of composition in German; the knowledge of history; the rudiments of geography, mathematical, physical, and political and linear and free-hand drawing. For the commercial division:—Decimal arithmetic and commercial calculations; drawing; the elements of the French language; geography.

To be admitted to the technical divisions the candidate must prove that he possesses the instruction necessary to follow the courses. Notwithstanding the liberty left to ordinary pupils as to the courses suited to them, they are bound to attend such as are indispensable for the specialty they have chosen.

The payment for each half-yearly term is as many florins as the student attends hours of lectures in a week, but cannot exceed 15 florins. There is also an entrance fee of five florins, and 42 kreutzers for the servants. For the private courses the fee is two florins per hour's lesson per week. Also for manipulations in the chemical laboratory the charge is five florins per half-year. Industrious students of limited means may be favoured with a reduction of these fees, or even exempted from all payment.

At the end of every year there is a public exhibition of the works of the pupils. When the studies of the preparatory mathematical division are concluded examinations are held, after which those who have passed well receive certificates of maturity, which qualify them for admission to the special or technical courses of the university. Prizes are given to pupils who pass brilliant examinations, and they are allowed a reduction of one year's military service. These examinations, which were instituted only in 1862, are very strict, as may be seen by the following results:

—In 1862, of 35 pupils examined, only 18 obtained certificates. In 1863, 25 were successful out of 36.

Each special division has a head or principal chosen from among its professors, and on him falls the duty of watching over the pupils and maintaining discipline. The whole establishment is under the care of a director, who is appointed every year by the King, and who must be one of the professors recommended by his colleagues. The academy is under the direct authority of the Minister of Public Instruction and Worship, who has the supreme management of all the establishments for instruction, and occasionally sends inspectors to visit and report on them.

The subjects taught, as well as the number of lessons for the preparatory mathematical division and for the commercial division, are shown in the following table :—

MATHEMATICAL DIVISION.

First Class.	Number of Hours' Lessons per Week.	
Plane and spherical trigonometry -	5, repetition	2
Elementary analysis - - -	4, „	2
Descriptive geometry - -	6, „	2
Plan drawing and surveying - -	2	—
Free-hand drawing - - -	4	—
German language - - -	2	—
English language - - -	2	—
French language - - -	4	—
Geography - - - -	2	—
General history - - -	2	—
Religion (Catholic or Protestant) -	1	—
Totals - -	34	6

Second Class.	Number of Hours' Lessons per Week.	
Higher analysis - - -	4, repetition	2
Geometry { Analytical - -	4, „	2
Geometry { Descriptive - -	4	—
Geometry { Applied - - -	3	—
Mechanics, 1st part - - -	6	—
Zoology - - - -	4	—
Architectural drawing - -	2	—
Free-hand drawing - - -	4	—
German literature - - -	1	—
French language - - -	2	—
English language - - -	2	—
History - - - -	2	—
Totals - -	38	4

Commercial Division.	Number of Hours' Lessons per Week.
Book-keeping	6
Commercial arithmetic	4
Commercial geography	3
Languages — German	2
Languages — French	4
Languages — English	4
Languages — Italian	5
Correspondence — French	2
Correspondence — English and Italian	2
Introduction to laws on bills of exchange	1
Free-hand drawing	2
Religious instruction (Catholic or Protestant)	1
Total	36

For the technical instruction the pupils are free themselves to determine, with the approbation of the principal professors of the special divisions, the plan of studies they intend to follow. Below are indicated the usual selections adopted, and the following synopsis of the courses professed shows all the extent of the instruction given in this institute:—

Subjects Taught.	Hours' Lessons per Week.	
Higher analysis, second part	2	—
Method of least squares	2	—
Geometry	2	—
Mechanics, second part	3	—
Popular astronomy	2	—
Mineralogy	4	—
Mineralogical exercises	2	—
Experimental physics	5	—
Mathematical physics	4	—
Exercises in physics	3	—
General and technical chemistry	6,	repetition 2
Chemistry for constructors	4	—
Analytical chemistry	2	—
History of ancient architecture; History of mediæval, rennaissance, and modern architecture	2	—
Graphic studies on the history of architecture	4	—
Freehand drawing	6	—
Drawings of ornaments and modelling in wax or clay	18	—
History of the most modern times	3	—

Subjects Taught.	Hours' Lessons per Week.	
Life and works of Göthe and Lessing	2	—
Languages: French	4	—
Languages: English	4	—
Languages: Italian	5	—
Political economy	3	—
Manufactures	2	—
Law and administration	5 to 6	—
Gymnastics	4	—
Exercises in wood carving and in mechanical workshops	—	—
Stæchiometry	2	—
Chemical exercises and manipulations	17	—
Mechanical technology	4	—
Chemical technology	3	—
Construction of machines, first part	4	—
Construction (exercises)	6	—
Construction of machines, second part	6	—
Construction (exercises)	6	—
Construction of machines, third part	3	—
Construction (exercises)	6	—
Preparatory course	4	—
Science of engineering, first part	8	—
Ditto, second part	12	—
Elements of building construction (lectures)	4	—
Ditto, drawing	10	—
Construction of large buildings (lectures)	8	—
Projects of constructions	6	—

The teaching staff consists of 29 persons.

These different branches of instruction are usually combined as follows:—

Architects and Builders.

First year.—Elements of construction, free-hand drawing and ornaments, mineralogy and geology, mathematical physics, chemistry relating to constructions.

Second year.—Construction, history of architecture, projects, knowledge of building materials, free-hand drawing, and ornaments.

Third year.—Large buildings, history of modern architecture, projects of buildings, estimates, ornament and free-hand drawing.

Civil Engineering.

First year.—Mechanics, second course; construction of machines, first course and exercises; elements of construction of buildings; applied geometry; free-hand drawing; mineralogy and geology; mathematical physics; chemistry for builders.

Second year.—Science of engineering, first course; construction of buildings, of machines, second course; free-hand drawing.

Third year.—Science of engineering, second course; construction of large buildings, of machines, second course; free-hand drawing.

The drawing class-rooms are open all day.

Mechanicians.

First year.—Construction of machines; elements of construction of buildings; mechanics, second course; technological mechanics; chemical technology; warming of houses; bridges.

Second year.—Construction of machines, second course; technical mechanics; technical chemistry; heating; bridges.

Third year.—Construction of machines, third course; hydraulic constructions; construction of buildings; account-keeping of works; political economy.

The drawing class-rooms are open all day.

Chemists.

First year.—General and technical chemistry; analytical chemistry; chemical technology; exercises in physics and mineralogy; heating.

Second year. — Analytical chemistry; chemical exercises; technical chemistry; exercises in physics and mineralogy; heating.

Third year. — Chemical manipulation; technical chemistry; law.

Metallurgists.

First year.—General and technical chemistry; mathematical physics; mineralogy and physical geography; construction of machines and exercises; elements of construction of buildings.

Second year.—Analytical chemistry; mechanical technology; exercises in chemistry, physics, and mineralogy; construction of machines and exercises; heating.

Third year.—Chemical exercises; chemical technology; construction of machines, third course, and exercises; political economy; law and administration.

Pharmaceutists.

The pupils are supposed to have attained all the requisite practical knowledge.

First year.—General and technical chemistry; analytical chemistry; pharmacopœia; zoology; botany; mineralogy and physical geography; experimental physics; stœchiometry and chemical manipulations.

Second year.—Chemical and mineralogical exercises; analytical chemistry.

The school possesses a library; collections of chemical products and apparatus, and of chemical technology; a cabinet of instruments for experiments in physics; mineralogical collections; geological and botanical collections; a collection of pharmaceutical products; a set of models for descriptive geometry; a collection of surveying instruments and architectural models, and a gallery of works of art; a number of reproductions for the illustration of ornament, and of the history of architecture; a collection of casts for free-hand drawing; a collection of examples for the different branches of drawing, and construction; a library of works on construction and art; and a technological museum. The building at present occupied by the school is too small, but another is preparing which will be all that can be desired.

The laboratory is well organized and kept in excellent order; it is divided into two principal parts, one for analytical the other for pharmaceutical chemistry. Every provision is made for a good supply of water, and there are stills, gasometer, sandbaths, furnaces for fusion and reduction, stoves, &c. The whole is ventilated by aspiration from underneath, so as to prevent any smells from spreading through the other parts of the building. The workshops are open for the use of the mechanical pupils, and are used by some of them.

The division for builders and architects comprised, in 1864, about 40 pupils. The studies are regulated so that, on completing their first year of special studies, they have to pass one year in the practical exercise of their profession. After this noviciate they assume the title of builders (*Werkmeister*). When they have passed their fourth year at the school, and have worked one or two years under the direction of an architect, they can take the title of architect, and are allowed to undertake the execution of works for towns.

The division of engineers had, during the same year, from 60 to 70 pupils, and an examination of the projects which they executed, and of the very detailed and most complete studies of bridges of all kinds made by them, prove that they have been judiciously taught, and have studied well.

In 1860–61 the teaching staff consisted of 13 principal professors, 13 assistant professors, 13 foremen of workshops, and 7 private tutors.

The total number of pupils was then 270, of whom 141 were architects, mechanicians and engineers; 51 chemists; 21 traders and manufacturers; 19 pupils intending to become professors, and 38 attended a variety of courses.

In 1864 the number had increased to 377, and then the first class of mathematics contained 62 pupils, the second class 37, the division of commerce 23, the division of architecture 89, the division of engineers 69, the division of mechanicians 53, and the division of chemists 44.

SPECIAL REPORT ON THE EDUCATIONAL ESTABLISHMENTS OF THE GRAND DUCHY OF BADEN.

PRIMARY SCHOOLS (*VOLKSCHULEN*).

In the Grand Duchy of Baden all children between the ages of six and 14 (except in cases of ill-health) are compelled to attend the primary schools.

Those who, however, with a view to acquiring a superior education, attend a public or private school of a higher order, or those who attend a private primary school kept by a master authorized by the school inspector of the district, or any other duly authorized private schools are specially exempted from attendance at these schools.

The instruction given comprises :—Religion, the German language, writing, arithmetic, singing, and other instruction of practical utility in natural history, the natural sciences, geography, history, hygienics, rural economy, agriculture, geometry, &c. Drawing is added, if the resources of the school permit. However, none of these supplementary subjects are to be taught, unless it can be done without interfering with the study of the more essential branches of primary instruction.

Every parish which possesses a primary school is bound also to have, during the winter season at least, a work school for girls, in which they learn the kinds of work proper for their sex, especially sewing and knitting. In any case, from the age of 11 till they leave the primary schools, girls must attend these work schools during the winter months. The Council of Education may, on the application of parents or guardians, dispense from attending these lessons such girls as receive the required instruction either at home or elsewhere. Two days per week, and two hours a day at least, must be devoted to this instruction.

FACTORY SCHOOLS.

Children bound to attend school cannot be exempted from so doing for the purpose of working in factories, unless they attend special schools, the establishment of which must be authorized by the superior council of instruction, and the expenses of which must be borne by the manufacturers. Children over 11 years of age who have not passed the two lower degrees of elementary primary instruction cannot attend the factory schools. Each division must receive on the average at least two hours teaching every day. The class hours must be, as far as possible, so arranged in the morning and afternoon as to precede the working hours; if this be impracticable the children must have at least an hour's recreation before they go to school. The sum total of hours for work and study, in the case of children who have not got beyond

the age when they can leave school (14 for boys and 13 for girls), must not exceed 12 hours. Children are allowed during the working hours, both morning and afternoon, a quarter of an hour's rest, and a whole hour at noon for play, with an opportunity of open air exercise in both instances.

There are factory schools at Haagen, Steinen, Lörrach, Laufenmühle, Ettlingen, and Schiltach, containing together from 400 to 450 children.

Improvement Schools.

In every parish during the winter half year, improvement schools are held which the boys who do not attend either a higher middle class school, or an industrial school, or some private establishment authorized by the Council of Education, are bound to frequent during the first two years after their leaving the primary school. These schools are open every week once or twice for two hours at least. It is only by exception and for special local reasons that they can be held in the evening, and in that case the police of the parish must take measures to prevent any disorder on the part of the boys attending them.

Here boys are exercised and improved in the subjects of instruction they have acquired in the primary schools, especially in writing, composition, and arithmetic. A greater portion of time than in the elementary schools is also devoted to imparting a practical acquaintance with natural history, the natural sciences, geography, history, and especially agriculture and the elementary principles of mechanics.

Sunday Schools.

These schools, which are kept for one hour every Sunday (festivals and vacations excepted), are attended both by boys and girls for three years (in large towns two years) after leaving the primary schools, and without exception both summer and winter. Boys who attend an upper middle class school, an industrial school, or any higher institution, or who receive a private education acknowledged sufficient by the Council of Education, and girls who attend a public school of a higher order, and are sufficiently acquainted with the subjects taught in the Sunday school are exempted from attendance.

Religious instruction is continued in the Sunday schools by using the class books prescribed for the purpose, and by reading select passages of the Holy Scriptures. The rest of the teaching for boys is devoted to those subjects which they study in the week-day improving schools.

The Grand Duchy of Baden also possesses three seminaries for training teachers for the primary schools, the Protestant seminary of Carlsruhe, where Jewish teachers are likewise admitted, and the Catholic seminaries of Ettlingen and Meersburg. Also a deaf

and dumb institute at Pforzheim, founded in 1783 by the late Margrave Charles Frederick, and a school for the blind at Freiburg, which was opened on the 22nd November 1828.

Agricultural Schools.

For instruction in agriculture the Grand Duchy possesses :— An agricultural school at Hochburg, near Emmendingen ; a school of horticulture at Carlsruhe ; a school of arboriculture at Carlsruhe, open for only eight or ten weeks in the year ; and a school of meadow culture, open only in winter, at Carlsruhe.

The number of pupils was :—

Years.	At the School.				
	Of Agriculture at Hochburg.		Of Horticulture at Carlsruhe.	Of Arboriculture at Carlsruhe.	For Graziers at Carlsruhe.
	Pupils.	Free Pupils.	Pupils.	Pupils.	Pupils.
In 1859–60 -	15	5	12	—	10
In 1860–61 -	15	4	9	10	16
In 1861–62 -	18	3	13	6	16

The knowledge of agriculture is also propagated in the primary schools, the masters of which are bound to give lectures on the subject beyond the limits of elementary teaching, properly so called, especially to the Sunday classes. The central commission of agriculture sends competent persons to see that this instruction is properly given, and awards prizes to the masters who perform this part of their duty with distinguished ability.

For the diffusion of knowledge concerning agriculture there is, under the direction of the central commission of the Grand Duchy, an agricultural society which extends its action over the whole country. At the end of 1862 this society numbered 11,934 members, and it publishes a weekly journal of agriculture, which has a circulation of 9,000 copies.

Veterinary School.

The old veterinary school of Carlsruhe was suppressed some years back, because the ground on which it stood was wanted for the enlargement of the polytechnic school. Since then, the young men who intend to follow that profession receive assistance from the Government to pursue their studies in foreign schools.

Trade Schools (*Gewerbeschulen*).

In every manufacturing town trade schools have been established for the purpose of giving suitable instruction to young artisans

not requiring a superior scientific education. The curriculum of these schools includes free-hand drawing of geometrical forms and figures, and the drawing of ornaments: arithmetic and the elements of algebra: geometry and geometrical drawing (working drawings): industrial economy and book-keeping by single entry: as well as exercises in reading and in written composition.

According to local requirements and the resources at command, the instruction comprises: the simple enumeration of the principal natural phenomena in physics: and as much of natural and chemical science as is useful in certain special branches, and in agricultural occupations. The application of mechanics to manufactures, with the description, construction, and calculation of the special machines used in the manufactures of the town and neighbourhood. A special course of instruction may be established also for any particular branches of industry.

The trade schools receive youths above the age of 14 who have commenced their apprenticeship or intend to do so almost immediately, and have attained the requisite preliminary instruction, which is merely that given in the primary schools. Journeymen are likewise admitted as pupils, provided they have received sufficient instruction, and can produce a certificate of good character. Admission is also readily granted to those who, following a trade not belonging to any corporation, wish to acquire useful knowledge by attending certain courses of lectures, as, for instance, the special course of physics for agricultural industries.

The instruction is given on Sundays and holidays, and partly on week days, and occupies, according to circumstances, a greater or less number of hours. Apprentices to special industries, for which the subjects taught in the trade are less necessary or less useful, are exempted from attending or they may be present at a portion only of the lessons. Apprentices also may be dispensed from attending the trade schools, if they have followed the first four years courses of a literary or upper middle class school, or if they can prove, by passing an examination, that they possess the instruction to be acquired in the fourth year of an upper middle class school. The burgomaster, or, if needful, the clergyman of the township, is empowered to pronounce penalties against masters who neglect the duty of sending their apprentices to the schools.

The trade schools are local institutions subsidized by the State. In 1862, the number of these establishments was 40, and their pupils amounted to 4,803. They were conducted by 34 professors and 36 assistants, the total sum of whose salaries, including the grant from the State, was, during the years 1860 to 1862, 30,533 florins.

In the school year 1851–52, there were only 30 trade schools, containing 1,855 ordinary pupils and 787 free pupils, or 2,642 pupils in all. Since then, the attendance has greatly increased, as shown by the following table:—

Years.	Total Number of Pupils.	Composed of		
		Journeymen.	Apprentices.	Pupils of no Trade.
In 1859–60 - -	4,275	329	3,343	573
In 1860–61 - -	4,461	424	3,472	565
In 1861–62 - -	4,803	461	3,635	707

These numbers would be still further increased if the statistics of all these establishments were complete. In the school years, from 1859 to 1862, the trade schools, 37 in number, were frequented as follows :—

Names of the Schools.	Total Number of Pupils.	Composed of		
		Journeymen.	Apprentices.	Persons of no Trade.
Constance - -	233	30	179	24
Neustadt - - -	65	3	54	8
Ueberlingen - -	52	2	48	2
Villingen - - -	85	6	74	5
Emmendingen - -	55	12	38	5
Freiburg - - -	361	58	302	1
Furtwangen - -	132	9	48	75
Saint Georgen - -	62	10	46	6
Schönau - - -	47	6	20	21
Triberg - - -	54	—	50	4
Waldkirch - -	78	6	40	32
Waldshut - - -	38	8	29	1
Baden-Baden - -	252	46	186	20
Bretten - - -	58	1	54	3
Bruchsal - - -	130	8	102	20
Bühl - - -	67	—	53	14
Carlsruhe - - -	304	1	302	1
Durlach - - -	84	5	79	—
Eppingen - - -	122	12	102	8
Ettlingen - - -	91	13	57	21
Gernsbach - -	81	5	46	30
Lahr - - - -	149	5	142	2
Oberkich - - -	40	—	35	5
Offenburg - - -	110	11	82	17
Pforzheim - -	483	28	451	4
Rastadt - - -	140	15	114	11
Wolfach - - -	33	—	33	—
Buchen - - -	99	3	50	46
Heidelberg - -	424	44	251	129
Mannheim - -	282	45	237	—
Mosbach - - -	65	3	49	13
Neckargemünd - -	27	—	26	1
Schwetzingen - -	115	6	55	54
Sinsheim - -	52	—	48	4
Tauberbischofsheim -	39	6	26	7
Weinheim - - -	76	8	67	1
Wertheim - - -	151	11	93	47
Total - -	4,736	426	3,668	642

Within the last year or two, new schools have been established at Meersburg, Vöhrenbach (canton of Villingen), and at Schönau (circle of Heidelberg).

From 1859 to 1862 the pupils belonged to the following trades :—

Joiners - - - - -	480
Smiths - - - -	382
Masons - - - - -	360
Gold and silver smiths - - -	251
Carpenters - - - -	200
Shoemakers - - - -	199
Tailors - - - - -	185
Watchmakers - - - -	169
Bookbinders - - - -	80
Saddlers - - - -	78
Stone cutters - - - -	70
Turners - - - -	59

To the trade school at Mannheim a preparatory school was added some years back, which had 38 pupils in 1861–62. It is intended for boys from 12 to 14 years of age, who on attaining their fourteenth year are to be apprenticed, and will then enter the trade school. At this the instruction is regulated as follows :—

Subjects taught.	Number of Hours per Week.
Religion - - - - -	2
German language - - - -	6
Geography and history - - -	2
Arithmetic and algebra - - -	4
Geometry - - - - -	4
Free-hand drawing - - - -	4
Geometrical drawing - - - -	4
French language (optional) - - -	4
Singing - - - - -	1
Total - -	31

Under the same name there is a school at Carlsruhe intended for apprentices under 17 years of age. The lessons are given in the morning, from six to ten o'clock in winter, and from five to nine in summer. This instruction is compulsory for all apprentices from 14 to 17 years of age, and the masters with whom they work are responsible for their attendance, which is proved every day by stamping their pass book. The means of punishment are a warning, a remonstrance, fine, and imprisonment; the master himself is liable to the same, if the apprentice's absence is caused by him. Besides lessons on working days, there are classes on Sundays, and in the evening for the workmen who please to attend.

The pupils are divided into three principal classes, which constitute three years of study. A fourth preparatory class receives those pupils who are sufficiently instructed to profit by the ordinary lessons. The studies are chiefly directed to arithmetic, with its applications to trade and industry; to practical geometry; projections and developments of surfaces; free-hand and linear drawing, specially applied to different trades; elementary mechanics; the elements of descriptive geometry; modelling; wood-carving. For the last two subjects there is a studio open to pupils from half-past seven to nine in the evening. In all these applications, especial care is taken to teach each pupil those most useful for his own profession.

There are in this school 300 pupils who are taught by a professor, a drawing-master, and a modelling master; the whole expense is only 1,900 florins, exclusive of house rent, teaching appliances, heating, and lighting, which are defrayed by the town.

Upper Middle Class Schools (*Höhere Bürger Schulen*).

The instruction given in these Schools comprises religion; the German, French, and Latin languages; general history; arithmetic; geometry, with practical exercises; geography; natural history; the natural sciences; technology; drawing; writing. singing. As a general rule, boys entering the lower classes must be 10 years of age. A complete upper school has courses extending over five or six years. The 24 upper schools of the Grand Duchy contained in the years indicated the following number of pupils:—

Names of Schools.	Number of Pupils.			
	1858-59.	1859-60.	1860-61.	1861-62.
Baden-Baden	125	128	114	115
Bischofsheim-on-the-Rhine	27	31	36	30
Bretten	43	52	50	56
Buchen	58	46	49	38
Constance	135	137	131	113
Eberbach	57	47	47	50
Emmendingen	55	59	57	63
Eppingen	47	46	50	62
Ettlingen	36	38	37	40
Ettenheim	222	225	206	218
Freiburg	184	187	186	186
Heidelberg	306	287	265	260
Gernsbach	—	—	—	28
Hornberg	32	26	24	30
Kork	13	16	18	15
Mannheim	284	285	276	287
Moosbach	101	101	76	67
Müllheim	92	90	83	86
Sinsheim	66	64	55	50
Schopfheim	45	44	51	50
Ueberlingen	40	50	53	56
Villingen	50	64	56	57
Waldshut	50	39	54	94
Weinheim	47	39	66	103
Totals	2,126	2,106	2,040	2,154

Under the same name there is, at Carlsruhe, a school analogous to the practical schools of Northern Germany. The studies are divided into seven classes, the two lower ones being double, owing to the number of the pupils. The instruction given is literary and scientific, and enables the pupils who have passed the higher classes to enter the polytechnic school.

The following table shows the nature of the curriculum :—

Subjects taught.	1st.	2nd.	3rd.	4th.	5th.	6th.	7th.	Totals.
Religion	2	2	4	2	2	2	2	16
German	4	4	4	2	3	3	3	23
Latin	.	5	4	4	3	4	4	24
French	5	5	5	5	4	4	4	32
English	.	.	.	3	3	3	3	12
History	.	.	2	2	2	2	2	10
Geography	3	2	2	2	.	.	.	9
Natural history	2	2	2	2	3	.	.	11
Arithmetic	4	4	3	2	.	.	.	13
Geometry and mathematics	.	.	.	3	5	5	7	20
Physics	.	.	.	.	.	2	2	4
Chemistry	.	.	.	.	.	2	2	4
Free-hand drawing	2	2	2	2	2	2	2	14
Linear drawing	.	.	1	.	2	2	2	7
Singing	2	2	2	2	2	2	2	14
Gymnastics	2	2	2	2	2	2	2	14
Caligraphy	2	2	2	1	.	.	.	7
	28	32	35	34	33	35	37	234

It appears from the above that, although this school is intended to give pupils a scientific education preparatory to the polytechnic school, the literary element is not neglected, as the German language occupies 23 hours, French 32 hours, Latin 24 hours, and English 12 hours per week, whilst arithmetic and mathematics together occupy only 33. Free-hand drawing is not over well taught ; there is too much copying of lithographs. As one of the applications of geometrical drawing, the pupils are practised in the projection and development of the more simple surfaces, which they execute on thin pasteboard.

This school, though established not long since, had, in 1864, 280 pupils.

Literary Schools (*Gelehrten Schulen*).

Under this designation are included the lycea, the gymnasia, and the pœdagogia.

The subjects taught in a lyceum are : — Religion ; German, Latin, Greek, Hebrew (for those who intend to study divinity), French, and (if the school funds will allow) Italian and English ;

mathematics, the natural sciences, natural history, geography, history, archæology, rhetoric, philosophy, caligraphy, drawing, singing, and gymnastics. Each lyceum has six classes and the course of study occupies nine years. The pupils of the lower classes must have completed their tenth year before admission.

All the schools which have not the means of teaching required to complete the programme, must divide the studies in conformity with its general spirit, and confine their teaching within limits proportioned to their resources Schools which carry on the studies as far at least as the seventh year inclusive, receive the name of gymnasium; the others are called by the name of pœdagogium.

The Number of Pupils was	1858–59.	1859–60.	1860–61.	1861–62.
In the pædagogium :—				
At Durlach - -	83	95	91	87
„ Lörrach - -	98	87	90	77
„ Pforzheim - -	185	195	207	218
Totals - -	366	377	388	382
In the gymnasium :—				
At Bruchsal - -	163	166	170	154
„ Donaueschingen -	93	82	82	80
„ Lahr - - -	146	117	132	134
„ Offenburg - -	130	126	143	126
„ Tauberbischofsheim -	222	191	178	158
Totals - -	754	682	705	652
In the lyceum :—				
At Carlsruhe - -	569	588	624	739
„ Constance - -	251	244	217	209
„ Freiburg - -	416	415	404	352
„ Heidelberg - -	196	186	203	228
„ Mannheim - -	267	252	252	263
„ Rastadt - -	157	136	136	161
„ Wertheim - -	150	163	172	161
Totals - -	2,006	1,994	2,008	2,108

School of Gymnastics.

At Carlsruhe there is a central school of gymnastics partly supported by the Government, the object of which is to train all those who intend to teach this branch of education. Those candidates who are already employed in teaching gymnastics in various degrees complete their training in this establishment; such persons as are employed in assisting the actual professors of gymnastics are also admitted. In case of need, assistance is granted to these candidates.

This institution is also in connexion with the establishments of public instruction at Carlsruhe, and especially with the lyceum. The pupils of the last-named schools receive their gymnastic lessons there, and a part at least of the pupils of other public schools may also be admitted.

Military Schools.

In 1820, the Grand Duke Louis founded the School of Cadets for the education of young officers; but its existing organization dates only from 1851. Youths are admitted to this school from 15 to 18 years of age, after being recognized as fit for the military service, and having proved that they possess the requisite instruction, which comprises all that is taught in the gymnasia of the Grand Duchy as far as the fourth class inclusively.

The studies last three years and embrace :—

Theoretical courses.—German and French, mathematics, the military code, tactics, the military art, fortification, history, geography, land-surveying.

Practical courses.—Infantry and artillery exercises, manœuvres and the use of arms, fortification, surveying, and reconnoitring.

Gymnastics.—Fencing and sword exercise; gymnastics, riding, swimming.

According to the budgets of 1862 and 1863, the number of cadets was then 60.

There is likewise at Carlsruhe an improving school for superior officers.

Universities.

The Grand Duchy of Baden has two universities, one at Heidelberg, founded in 1386 by Robert I., the other at Freiburg, founded in 1454 by Albrecht VI., Archduke of Austria.

There is also a seminary for Catholic priests at Freiburg, and the Catholic theologians who are candidates for degrees, must pass the last year of their studies in practical exercises at the seminary of St. Peter.

Upper School for Girls.

Under this designation there is, at Carlsruhe, a municipal institution which educates young girls of the middle classes from the age of 6 or 8 to 16 or 17. Besides the primary studies the pupils receive a more extensive literary education, and many of them are sufficiently well taught to act as governesses abroad, more especially in France. Other schools of the same kind are kept by private individuals in various parts of the country, and there is one at Offenburg managed by the nuns of a convent existing in that town.

In the Carlsruhe school there are 284 pupils, and the instruction is given to them in five classes, as follows :—

Classes.	Number of Pupils.	Age.	Number of Hours per Week.														
			Religion.	German Language.	German Literature.	French.	English.	Geography.	History.	Natural History.	Physics.	Arithmetic.	Caligraphy.	Singing.	Drawing.	Needlework.
I. {Higher / Lower}	46	6 to 8	2	11	–	9	–	–	–	–	–	–	1	–	–	12
II. {Higher / Lower}	66	8 to 10	2	5	–	9	–	1	–	–	–	3	3	2	–	11
III. {Higher / Lower}	68	10 to 12	2	4	–	8	–	2	–	1	–	2	2	2	2	11
IV. Two years of study.	64	12 to 14	2	4	–	8	–	2	2	2	1	2	2	2	2	6
V. Two to three years of study.	40	14 to 16	2	4	3	9	4	2	2	–	1	2	1	1	2	5
Total -	284	—	10	28	3	43	4	7	4	3	2	9	8	7	6	45

The school fee is 16 florins a year in the first class, 30 florins in the second and third, 36 florins in the fourth and fifth class ; there is also an entrance fee of one florin.

Every care is taken to engage, for the living languages, masters who have a good pronunciation. Singing and music are also well taught, but in drawing there is room for improvement. Instruction in needlework and other feminine occupations is given under the direction of competent mistresses, who give all their explanations in a foreign living language which the pupils must be able to speak.

The Government is anxious to increase the number of these schools, and to give some of them a commercial and somewhat industrial character.

School for Clock and Watchmaking at Furtwangen.

Since the sixteenth century the manufacture of clocks has been one of the staple trades of this part of Germany ; and in 1847 it is estimated that there were more than 4,000 persons employed in watchmaking. In the year 1849 a special school for this branch of industry was established, and the place selected for its seat was Furtwangen, in the canton of Freiburg, the old centre of the clock manufacture in the Black Forest.

This school now comprises: — 1. A general trade school (*Gewerbeschule*) teaching more especially everything connected with clockmaking. 2. A purely practical school, with workshops for improving workmen in the different branches of the art, and provided with everything required for promoting the progress of horological manufactures in Baden generally.

Industrial school.—The instruction given here consists of three courses, each occupying a year. The classes are always held in the morning, beginning at six o'clock in winter, and at five in summer, and vary from seven hours to fifteen and a half hours per week for each class of pupils. Moreover, seeing the general importance of free-hand drawing, three hours are devoted to it every Sunday for apprentices and workmen. The clockmaking school even supplies pupils of insufficient means with all the necessary material.

For children of either sex, between the ages of eight and fourteen, there are three courses of drawing. Instruction in modelling is given to joiners, sculptors, and painters, if they desire it. Besides, pupils are also taught moulding, the art of casting, of taking impressions on various materials, gilding on wood and stone, burnishing, varnishing, polishing, copper plate printing, &c.

In 1861 this school had 49 pupils and seven free auditors.

There are:—1. A principal professor of special drawing, of mechanics, of the knowledge of machines, of applied physics and chemistry. 2. A professor of free-hand drawing, of ornaments, modelling, and decoration. 3. An assistant master for German, arithmetic, geometry, geometrical constructions, and commercial accounts.

The instruction is thus distributed among the three classes:—

First Class.

Arithmetic and plane geometry - -	3 hours.
German language - - -	2 „
Geometrical constructions; drawing applied to clockmaking - - -	2 to 3 „
Free-hand drawing - - -	1 to 3 „

Second Class.

Arithmetic and geometry, surfaces, volumes, curves, &c. - - - -	2 to 3 hours.
German, contracts, commercial correspondence - - - - -	2 „
Book-keeping - - - -	1 „
Applied mechanics and physics, power and work, centre of gravity, the pendulum, simple machines, lever, wedge, screw, pulley - - - -	2 „
Motions of clockwork, generalities on the measure of time, constituent parts, and their relations - - - -	1 „
Drawing geometrical constructions, penetrations, curves for the teeth of wheels, tools - - - - -	2 to 3½ „
Free-hand drawing with the pencil, shading - - - -	1 to 3 „

Third Class.

Arithmetic and mechanics, problems in clockwork, transformation of movements	1 to 2 hours.
Motions of clockwork, calculation of wheels; the different kinds of clocks, the best escapements, tools, and machines - -	2 „
Applied physics, especially with relation to clockwork - - - -	1½ „
Special drawing for clockwork - -	4 „
Free-hand drawing, shading - -	1½ „

Workshops for improvement.—There are at present three of these workshops, two for watches and one for clocks.

The first watch workshop admits young men who intend to follow the trade, and gives them all the means of becoming expert workmen. The second shop is a continuation of the first, that is to say, as soon as a young man has acquired in the first sufficient skill to take part in the manufacture of watches, he is at liberty either to enter any private manufactory or to pass into the second shop, where he continues to work under the direction of the professor, at the same time receiving wages. Skilful watchmakers are also received in this second shop to work by the piece. Both these shops are under the same roof as the school. The workshop for clocks is, on the contrary, owing to want of room, in the residence of the professor, and as he keeps a workshop of his own for clocks, the organization is analogous to the one we have described for watches. Every pupil has a place to himself like a workman; the tools are exactly the same as in a complete watch and clock manufactory, organized according to the best and most recent processes, and on the system of division of labour.

The workshops are never closed for want of work; but there are holidays at Easter, at the end of the school year, and in Carnival time, just the same as in the other manufactories of the Black Forest. The working hours are, in accordance with the general usages of the trade, from 7 to 11.30 a.m., and from 1 to 7 p.m., that is 10½ hours' work per day. The apprentices, who are exceptionally excused from attending the classes of the industrial school, are therefore employed 60 hours per week in the workshops. As a general rule, however, the apprentices are bound to attend the industrial school, so that those in the first class have seven hours' instruction, and 58 of practice in the workshops, in all 65 hours in winter; those of the second class, 12 hours and 54 hours, or 66 hours in all; those of the third class 7 hours and 58 hours, or 65 hours. In summer the theoretical courses begin at an earlier hour, which prolongs to 66 or 68 hours the time employed per week.

In the workshop for clocks the hours of work, according to the custom prevalent in the Black Forest, are 13 per day. In the second shop those who work by the piece can leave off at dusk.

There is no time fixed for pupils to remain in either workshop; their stay depends on the aptitude, application, and progress of each individual. In general the apprenticeship does not exceed

three years. In the contract signed on entering, the pupil engages to pay a certain sum in case he leaves the school by his own desire, or if, on withdrawing from the watch workshop, he leaves the Black Forest. In all other cases the instruction is gratuitous.

Each of the two workshops has benches for 10 pupils, the number of practical pupils, therefore, cannot exceed 20.

Workshops for watches.—The principle of division of labour is adopted in these shops, so that, as soon as a pupil possesses a general knowledge of the trade, he is advised to select the particular speciality for which he has most aptitude, or which best meets the actual wants of the establishment.

The instruction therefore consists: 1. Of a general part common to all the pupils. 2. Of a part special to each pupil, and which will render him perfectly competent to undertake one or more of the branches forming the complete manufacture. 3. Of a part intended to form workmen thoroughly versed in both the practice and the theory of the art.

The first, or general part, forms the basis of all the subsequent instruction, and is, therefore, of the utmost importance. While the pupils are going through it the professor has ample opportunities of appreciating their capabilities and of deciding what special branch will best suit them.

In this part of the course the pupil has to acquire [illegible] in filing, turning, drilling, polishing, &c.; a knowledge [illegible] ment of materials, hardening and annealing of steel, hamm[illegible] hardening of brass, &c.; the power of making small tools, such as punches, drills, counter-sinks, rimers, screw taps, &c.; the use of the simple machine tools; a facility of producing pieces in the rough, a knowledge of the constituent parts of a watch, the practice of drawing watches, and all their parts.

The details of the practical teaching are so numerous that it is impossible to give them here. Strict attention is paid to the perfection of the work, and to the exact proportions of size. The parts most minutely examined for the making of the pieces in the rough are the lever escapements, the balances, the cutting and setting of the jewels, the position of the wheels, &c. The instruction of the complete watchmaker embraces a knowledge of all parts of the divided labour; it must also familiarize the pupil with the geometrical proportions of the parts of a watch, enable him to judge of its movement, to undertake improvements, and even to devise new systems.

This instruction is given by a professor and his assistant, both practical watchmakers.

In the year 1860 there were 13 pupils, four of whom had completed the course at its close. In 1860–61 there were only 11 pupils, as none are admitted but those who display more than the average talent.

Workshops for clocks.—The object of these is to improve this branch of manufactures in the Black Forest. Owing to the peculiar organization of the clock manufacture, it is very difficult to establish the principle of division of labour in this branch; the instruction given, therefore, is such as to enable every pupil

to take any work that he can obtain in establishments already existing, or to set up a workshop of his own. It is indispensable that, while more especially cultivating the branch for which he feels most inclined, he must none the less learn to make complete movements, and to prepare the different pieces in the rough.

The instruction is divided into:—1. The general elementary teaching common to all the pupils. 2. The general improvement of the pupil in all the branches, but with a more particular study of that for which the pupil is but fitted.

The pupil has to acquire: — Dexterity in filing, drilling, turning; the knowledge of materials, and manner of treating them; the making of the different tools; instruction in the use of the various machines required in the manufacture of clocks; the knowledge of the constituent parts of a clock, their purpose, and execution. The concluding instruction consists in teaching how to make the cases, barrels, and wheels; the moving powers; the conditions indispensable for good working of the wheels; the making of ordinary movements; striking and repeating clocks; finishing with pieces in the rough. As there are always in the workshops pupils of various degrees of proficiency, the last course cannot be divided into sections.

As has been stated the pupils before leaving must be able Both these workshop finish off but also to prepare the different parts in the in otherwise they could not be of much use in the present manufactories of the Black Forest. It is nevertheless necessary for them to know the system of the division of labour, and the use of the more expensive and more perfect machines, so as to be able to take advantage of them whenever an opportunity occurs.

The instruction is given by a professor, and the ten benches are full.

The Furtwangen school has in all six professors, one of whom is director; there are also two workmen and one man servant.

During the last year there were:—

		Pupils.
In the industrial school of the first year	-	29
„ „ of the second year	-	11
„ „ of the third year	-	9
In the workshops for watches	-	14
In the workshops for clocks	-	17
Total	-	80

Fifty-four boys, from 8 to 14 years of age, and 18 girls, from 8 to 13, have attended the school for free-hand drawing.

The yearly sum allowed for the school by the Government is at present 10,000 florins.

Plaiting Schools.

Another of the staple industries of the Black Forest is straw-plaiting, and this also has been encouraged by the opening of

schools. In 1851 a school for girls was established at Furtwangen under an able mistress, and in this school skilful workers were trained who have since themselves become mistresses. Numerous other schools for straw-plaiting have been opened in the Black Forest.

Workmen's Society (*Arbeiterbildungsverein*).

The object of this association is to enable journeymen to acquire knowledge useful in their trades or general instruction, to cultivate singing, to found instructive and amusing lectures, to take measures for the establishment of savings' banks and benefit societies. For the more easy attainment of these ends this association is connected with the industrial society.

The admission fee is 12 kreutzers, and the monthly subscription 15 kreutzers, to be paid on the first Thursday in every month. Sick members do not pay during their illness.

The society is managed by a committee composed of 12 members, half of whom are elected every six months by ballot. The committee meets once a week. All expenses exceeding 5 florins must be submitted to a general meeting, except in cases of urgency. General meetings are held once a fortnight to transact ordinary business.

It is in correspondence with similar societies in the Grand Duchy and abroad, in order to secure to its members the same paternal reception which it accords to others. Whenever the number of members is reduced to six, the society is *de facto* dissolved. Its funds are then invested to become the property of any new society founded in the same locality, after it shall have existed two months.

The following are the subjects taught:—Sunday, at 9 a.m., drawing; at 8 p.m., exercises on the manner of treating questions; Monday, general meeting, interesting questions of natural science, singing, declamation; Tuesday, book-keeping and correspondence; Wednesday, history of Germany; Thursday, German language and singing; Friday, history and literature; Saturday, arithmetic and singing—all at 8 p.m.

The society has a library of about 200 volumes, and a reading room which is open every evening. In 1863 the society counted 197 members, of whom 130 were journeymen and 67 friends of industry; among the workmen were 44 joiners, 21 tailors, 11 shoemakers, four wheelwrights, &c. The non-workmen were manufacturers, tradesmen, professors, and civil functionaries.

Polytechnic School.

The Carlsruhe Polytechnic School, founded in 1825, is justly regarded as one of the most excellent establishments of the kind in all Germany. The noble building it occupies cost 40,000*l.* It contains spacious class rooms for all the studies of the pupils, fine amphitheatres large enou h to seat 230 hearers, an extensive

and well-arranged laboratory, and well organized workshops, in which are executed, perhaps at rather too great cost, but in the most perfect manner, the models to complete the excellent collection already existing. The whole of these collections constitute an establishment of the highest order, well worthy of its great reputation.

The number of pupils in the school for the year 1863–64 was 589, distributed as follows :—

Divisions.	Badeners.	Foreigners.	Totals.
Mathematics	66	76	142
Engineers	44	62	106
Architects	36	56	72
Foresters	33	14	47
Chemists	12	14	26
Mechanicians	18	103	121
Posts and commerce	32	4	36
Free auditors	18	21	39
	259	330	589

This table shows that the divisions for mathematics, engineering, and mechanics are by far the most numerously attended. Of the total number of foreigners France sends 2, Prussia 64, Russia 44, Bavaria 25, Switzerland 20, Austria 17.

This establishment is a kind of technical university, which, in addition to scientific studies of a high order, comprises in its organization several special divisions. The first of these is devoted not merely to mathematical science, as its name would seem to indicate, but also to the general scientific knowledge necessary for the other technical divisions, and which the pupils may acquire by following the particular courses relating to those sciences.

The technical divisions are :—

Engineers		requiring 2 or 2½ years.	
Architects	Builders	„	2 „
	Architects	„	4 „
Foresters		„	2 „
Chemists		„	2 „
Constructors of machines		„	2 „
Commerce		„	1 „
Posts		„	1 „

The only qualification for admission is that the candidate shall possess the requisite instruction to enable him to follow one of the divisions. There is no absolutely compulsory series of study ; the examinations alone impose on the pupils the necessity of acquiring the necessary instruction, and thus indicate to them the courses which are indispensable.

Mathematical Division.

The studies of this division extend over two years. For admission to the first year's course the candidate must be above 17 years of age, and must prove that he is sufficiently acquainted with elementary mathematics, and can treat of a given subject in the German language. A candidate may enter the second year's course at once on showing that he knows the subjects taught in the first year, and that he is 18 years of age. The following is the programme of studies :—

First Year :—

Differential and integral calculus	5 hours.
Plane and spherical trigonometry	2 „
Analytical geometry of two dimensions	2 „
Descriptive geometry	6 „
Elements of mechanics	5 „
Experimental physics	4 „
(And one hour of repetition.)	
German language	2 „
French language	3 „
Free-hand drawing	2 „
Modelling	4 „

Second Year :—

Differential and integral calculus	4 „
Analytical geometry of three dimensions	2 „
Analytical mechanics	5 „
Descriptive geometry	4 „
Technical drawing	4 „ (summer)
Practical geometry	4 „
Higher physics	3 „ (winter)
Physical experiments	6 „ (summer)
General chemistry (course of the chemical division)	4 „
Mineralogy and geology	3 to 4 „
German literature	2 „
French language	3 „
English language	3 „
Free-hand drawing	4 „
Modelling	4 „

Division of Engineers.

This division prepares for all the branches of the profession, military engineering excepted.

To be admitted the candidate must possess the knowledge acquired in a gymnasium or lyceum as far as the second class, and that of the two years' mathematics of the preceding school. In the absence of certificates, the candidate must pass an examination.

The studies occupy two years according to the following programme:—

	Hours.
First Year:—	
Calculation of variations - - (in winter)	2
Surveying - - - - - -	2
Method of least squares - - - -	1
Applied mechanics - - - -	3
Technological chemistry - - - -	3
Roads, hydraulic constructions (with three afternoons of experiments) - - - -	5
Construction of machines - - - -	12
German literature - - - -	1
Ancient and mediæval literature - - -	5
Practical construction in wood and stone - -	4 to 6
Free-hand and landscape drawing - - -	4
English language - - - - -	3
Second Year:—	
Bridges and roads - - - - -	6
Construction of railways - - - -	2
Exercises in practical building every afternoon in winter, and both morning and afternoon in summer - - - - - -	
Construction of machines - - - -	6
Questions in mathematical physics - (summer)	2
Popular law - - - - -	2
German literature - - - -	5
Ancient and mediæval history - - -	5
Free-hand and landscape drawing - - -	4

Third Year.—This course, which is one of six months only, is intended for engineers who intend to practise in the Grand Duchy. They have to familiarize themselves with the regulations and usages as to contracts for public works, as well as to price currents (two hours per week).

Drawing up of projects, specifications, estimates	8 hours.
Higher architecture - - - -	3 „

The pupils are taken out for excursions to building yards and works in course of execution; in this case the lessons are interrupted.

Division of Builders.

This division is subdivided into two parts; the lower section is intended to train builders (*werkmeister*), capable of projecting and executing all ordinary buildings for dwellings and manufacturing purposes. The higher division is meant to train architects in the higher sense of the word, and those who pass through it are expected to improve themselves subsequently by travelling to study the more remarkable creations of their art.

This division require four years' study; the qualifications for admission are the same as for the engineering division, except

that only the first year's course of the mathematical division is necessary.

	Hours in Winter.	Hours in Summer.
First Year :—		
General and inorganic chemistry (chemical course, 1st division)	4	4
Mineralogy and geology	3 to 4	3 to 4
Building materials	2	2
Descriptive geometry	4	4
Statics of buildings	2	2
Architectural drawing from copies	4	6
Drawing of plans	4	6
Landscapes	4	4
Drawing of ornaments	4	6
Modelling in plaster	4	—
Building arches in the yard	—	4
Modelling in wood	4	4
Ancient and mediæval history	5	5
German literature	1	1
Second Year :—		
Knowledge of machines	6	6
Bridges and roads	5	5
Technical architecture	4	4
Elementary studies of projects	2	2
Architectural drawing from models and copies, projects	4	6
Projects of dwelling houses	4	6
Landscape drawing	4	4
Drawing ornaments from copies	4	6
Modelling in plaster	4	—
Building arches in the yard	—	4
Modelling in wood	4	4
Ancient and mediæval history	—	—
Literature	—	—
Third Year :—		
Technical course of architecture, 2nd part	3	3
Higher art of building	3	3
History of ancient architecture	2	2
Plans of dwelling houses	6	9
Graphic studies on the more remarkable orders and edifices	2	3
Aerial perspective	2	3
Drawing ornaments from models and nature	3	3
Drawing of figures	4	4
Free-hand drawing	4	4
Modelling from models	5	4
Ancient and mediæval history	—	—
German literature	—	—

	Hours in Winter.	Hours in Summer.
Fourth Year :—		
Popular law - - - -	2	2
Higher art of building - -	3	3
History of mediæval and modern architecture - - - -	2	2
Projects of great public buildings -	6	9
Study of the architecture of the middle ages and copying of the principal monuments - - -	2	3
Perspective views in water colours -	2	3
Drawing of ornaments - -	2	3
Figure drawing from plaster models and nature - - - -	4	4
Free-hand drawing - - -	4	4
Modelling from nature or fancy -	5	4
Ancient and mediæval history -	—	—
German literature - - -	—	—

The mornings left free are devoted to graphic studies, and, at the end of the school year, there is a competition for the fourth class. A gold medal is given for the best project.

In these programmes for the architectural division, it is worthy of remark that there is no mention of mathematical instruction with regard to the stability of buildings, the strength of materials, &c. Such being the case, it is not easy to see the utility of the high mathematics and mechanical analysis required for admission into this division, the first two years of which are intended to form builders and overseers of works. It would, perhaps, be better to require less of the higher mathematics and more of the applications of the principles of science to the art of building. The practice of exercising the pupils of this division in the actual construction of various arches appears to be excellent. But as this can only be executed in bricks, it should not set aside that of making vaults and other constructions in plaster on a reduced scale, which oblige the pupils to trace all the panels and completely realize the different parts.

After the first two years' studies, the pupils who have no higher ambition than to become builders or overseers of works have acquired sufficient theoretical and practical instruction.

Division of Foresters.

The instruction of this division consists of:—1. A preparatory course; 2. Two years' studies. To enter the preparatory course, the qualification required is proficiency in the subjects taught in a lyceum as far as the second class, or else in all the classes of a gymnasium. The following is the programme:—

	Hours.
Preparatory Course.—	
Arithmetic and algebra - - -	3
Plane and solid geometry - - -	3

	Hours.
Experimental physics	4
General and special botany	4
Zoology	3
Botanical excursions and observations once a week in summer.	
History of German literature	2
Popular law	2
Rudiments of forest science	2
Practical instruction in forest questions and in the accounts of forest administration	—
First Year.—	
General arithmetic and algebra	2
Plane polygonometry, spherical trigonometry	2
Mathematical forest exercises	4
General chemistry	4
Mineralogy (winter)	3
Geology (summer)	4
Practical mineralogy	2
General botany, anatomy, chemistry, physiology, geography (winter)	4
Climate, meteorology, knowledge of soils	3
Natural history of timber trees	2
Forest management (winter)	3
Forest dues	2
Practical geometry	4
Excursions and explanations in the forest	—
Botanical excursions	—
Second Year.—	
Solution of problems	2
Agricultural chemistry	2
Administrative science, political and financial economy	2
Roads and hydraulic constructions (elements)	2
Guarding and protecting of forests	2
State of forest science	2
Working and valuations after rational methods	4
Valuation of the soil and produce of the forest as the basis of their real worth	2
Notions on the chase	2
Forest administration	2
Forest police	3
Forest laws and those of the chase	2
Excursions and journeys with applications.	

Division of Chemists.

This division is especially devoted to young men who purpose following careers in which a knowledge of chemistry, physics, and natural history may be useful, whether they intend to devote

themselves to chemistry or to engage in mining or metallurgical works. Admission is free to all who possess the instruction necessary for following the courses, and are full 17 years of age. The subjects taught are summarily stated in the following programme :—

	Hours.
General chemistry, 1st course, inorganic part (winter term)	4
Organic chemistry (summer term)	4
General chemistry, 2nd course, history and philosophy of chemistry (one year)	1
Repetition of chemistry (winter)	2
Conference on chemical analysis (summer)	2
Art of assaying metals	—
Manipulations in the laboratory	—
Qualitative and quantitative analysis	—
Agricultural chemistry (winter)	2
Chemical technology, organic and inorganic, various manufactures (one year)	3
Metallurgy (one year)	2
Experimental physics	4
Repetitions of physics	1
Higher physics	—
Botany and geology	7
Mineralogy (winter)	3
Physical geography (summer)	4
Knowledge of useful minerals (winter)	2
Practical mineralogy, excursions, &c. (summer)	2
Crystallography (winter)	2

This very extensive curriculum constitutes a series of courses which may be followed, not only by the pupils more especially destined for the chemical arts, but also for those of the other divisions. To take part in the chemical manipulations, the pupils pay 44 florins a year, and are supplied with all the needful re-agents.

Division of Constructors of Machines.

The qualification for admission is the instruction acquired by a pupil during the first year of the mathematical division. The whole course takes two years. The number of hours per week devoted to each subject is indicated in the following programme :—

First Year.—	Hours.
On machines	6
Construction of machines	4
Arrangements of machines	6
Experimental physics	4
Applied mechanics	3
Practical geometry	—

	Hours.
Mechanical technology	2
Chemical technology	—
Metallurgy	—
Knowledge of useful minerals	2
Roads and hydraulic constructions	5
Free-hand drawing	4
Ancient and mediæval history	5
Practice in workshops from 4 to 6 p.m.	—
German and French literature	4

Second Year.—

On machines	6
Construction of machines	4
Putting up machines	6
Mechanical technology	2
Select questions of mathematical physics	2
Higher physics	6
General chemistry	4
Id. repetitions (winter)	2
Road and hydraulic constructions	6
Railways (summer)	2
Chemical technology	—
Metallurgy	—
Ancient and mediæval history	—
German literature	—
Free-hand drawing	4
English language	4
Practice in workshops from 4 to 6 p.m.	—

Commercial Division.

The qualification for admission to this division is the instruction that can be acquired in an upper middle class school. The instruction is given according to the following programme:—

	Hours.
On commerce	5
Book-keeping	2
Commercial correspondence	3
Commercial arithmetic	3
Knowledge of merchandise	3
Commercial geography	3
Commercial history	1
Languages — German	4
Languages — French	4
Languages — English	3
Caligraphy	2
Drawing	2

Post Office Division.

The qualification for admission is the degree of instruction acquired on leaving the upper class of a gymnasium or the higher division of the fifth in a lyceum. Two years are required to complete the courses which are arranged as follows :—

	Hours.
First Year.—	
Arithmetic	3
Mechanics	3
Experimental physics	4
French language	4
German language	2
Caligraphy	2
Second Year.—	
Political arithmetic	3
Geography	2
General notions of political economy (summer)	2
Popular law	2
Commercial law	3
Application of mechanics to conveyance	2
Ancient and mediæval history	5
German literature	2
French language	3
French literature	2
English language	3
Caligraphy	2

Management.

The committee of management consists of a director, two councillors, the librarian, the secretary, and an accountant. The staff of teachers, professors, assistant professors, and masters is arranged as follows :—

	Prof.	Assist.
Mathematics	4	2
Natural sciences	6	2
Architecture and building	4	1
Bridges and roads	3	—
Knowledge of machines	3	—
Forest sciences	3	—
Commerce	2	—

	Masters.
General courses (languages and literature)	9
Sculpture	1
Caligraphy	1
Workshops	3

Summary.

A general recapitulation of all the educational establishments for all classes of citizens shows that the Grand Duchy possesses :— Infant schools ; Primary schools ; Factory schools ; Sewing schools for girls ; Week-day improving schools ; Sunday schools ; Normal schools for primary teachers ; Deaf and dumb schools ; Blind schools ; Agricultural schools ; Veterinary schools ; Professional schools; Superior burgess schools ; Literary schools ; Gymnastic schools ; and Military schools. Also a Polytechnic School, containing a division of: —the higher sciences ; engineers ; architects, foresters, chemists, constructors of machines, commerce, post office service, and telegraphy. Besides these there are two universities.

It is evident from the above that in the Grand Duchy of Baden, public instruction is organized in a manner to satisfy all literary and scientific requirements, as well as those of the public service and of industry.

This complete system which meets all the intellectual wants of the population according to their qualifications, social position, or resources, while it secures the material prosperity of the country and its inhabitants, contributes at the same time to moral improvement, and to political tranquillity.

PART II.—REPORTS AND NOTICES OF VARIOUS ESTABLISHMENTS FOR TECHNICAL EDUCATION IN FRANCE.

REPORT ON THE HISTORY AND PRESENT CONDITION OF THE IMPERIAL CONSERVATORY OF ARTS AND TRADES AT PARIS.

Origin of the Conservatory.

The first attempts to form a collection of machines and looms such as that now kept at the Paris Conservatory were made by Vaucanson, at the Hotel de Mortagne, in the Rue de Charenton, where he allowed artisans to study them for the purpose of instruction. At his death he bequeathed the whole to the Government, which accepted the legacy and purchased the Hotel de Mortagne. M. de Vandermonde was the first curator of this industrial museum, and, under his skilful management, from 1785 to 1792, 500 new machines were added to the collection.

As soon as the revolutionary tempest began to subside, and men's minds had returned to a calmer state, measures were taken to collect and save from dispersion the artistic and industrial riches of the institutions which had been destroyed. The Convention, by a decree of the 23rd Pluviose, year II. (11th February 1794), appointed a temporary commission on which were placed several persons eminent in the sciences and industrial arts, for the purpose of collecting in suitable depositories *the books, instruments, and other objects connected with science and art that might be useful for public instruction.* These articles, obtained from numerous and different sources, among others from the collection of models belonging to the old Academy of Sciences, were consigned, some of them to the Louvre, others to the Rue de l'Université, and the rest were added to the collection at the Hotel de Mortagne.

Original constitution.

Such was the still precarious state of things when, on the 19th Vendémiaire, year III. (13th October 1794), the National Convention, on the motion of Grégoire, Bishop of Blois, adopted a decree which formed the first regular constitution of the Conservatory of Arts and Trades. These fundamental articles were as follows:—

"Art. 1. There shall be formed in Paris, under the name of *Conservatory of Arts and Trades,* and under the inspection of the Commission of Agriculture and Arts, a collection of machines, models, tools, designs, descriptions, and books in all kinds of arts

and trades; the originals of instruments and machines invented or improved shall also be kept at the Conservatory.

"Art. 2. Explanations shall there be given on the construction and use of tools and machines employed in arts and trades.

"Art. 3. The Commission of Agriculture and Arts, under the authority of the committee with which it is in communication, shall in such quarters as may be deemed useful to the Republic, use every means of improving arts and trades, and principally by the distribution of descriptions, designs, and models.

"Art. 4. The Conservatory of Arts and Trades shall be composed of three demonstrators, a draughtsman, &c."

The premises at first selected for the seat of the Conservatory were the buildings of the *Garde-Meuble* (furniture stores), but political changes and other causes prevented this design from being realized.

Temporary suspension of the Conservatory.

The constitution of the Conservatory, and the functions attributed to it, among which was the duty of awarding prizes to citizens who had introduced useful inventions, led to so great an increase of the collections that it was indispensable to provide premises extensive enough to receive them all. An application was accordingly made to the Directory that the old Abbey of St. Martin might be granted for the purpose.

But this request, though granted by the executive, was not sanctioned by the Council of Five Hundred, which, in the sitting of the 14th Vendémiaire, Year V. (5th October 1796), under the pretext of economy adopted the following resolutions:—

"That, for the present, no further outlay shall be made on account of the Conservatory of Arts and Trades, except what is absolutely necessary to prevent the loss or deterioration of the instruments and machines. In consequence, all the salaries of the members and servants of the Conservatory are suspended."

"That the National Institute shall express its opinion as to the most economical means of bringing into one place those of the said instruments and machines which are worth preserving, and of rendering them serviceable to the Republic."

Removal to the Abbey of St. Martin.

Notwithstanding these resolutions, which apprised the members of the Conservatory that it is sometimes dangerous to be too zealous in one's duties, they nevertheless persisted in their efforts, and, on the 7th Nivose following, the Council of Ancients, acting on a very energetic report drawn up by Alquier, rejected the resolution of the Council of Five Hundred, and adopted the following:—

"Art. 1. The portion of the buildings of the old Abbey of St. Martin-des-Champs, and the grounds tinted red on the plan annexed to this resolution, are placed at the disposal of the Executive Directory for the use of the Conservatory of Arts and Trades.

"Art. 2. A sum of 59,600 francs, to be taken from the funds voted for the extraordinary expenditure of the year VI., is placed at the disposal of the Executive Directory for the repair of the said buildings, for appropriating the premises to their future use, and for paying the indemnity, if any be due, to the sub-tenant of the said buildings."

These buildings, however, which had been used as a manufactory of arms, were not transferred to the members of the Conservatory till the 12th Germinal of the Year VII. The members at the time were:—J. B. Leroy, Conté, and Molard, demonstrators, and Beuvelot, draughtsman. Some time after Montgolfier replaced Leroy, and Grégoire succeeded Conté. This mode of management was retained till the year IX., Molard then became sole manager, and the council ceased to meet.

Drawing school.

As early as 1796, when drawing, applied to industry and descriptive geometry, which is its basis, were not taught in any establishment intended for industrial education, Molard had attempted to annex to the collections an elementary school of drawing and of the first rudiments of the geometrical sciences. From this school, then almost the only one of its kind, proceeded a number of pupils who, in different ways, became useful to their country, and several eminent manufacturers, among whom the Conservatory can mention with pride M. Sellière, spinner at Senones (Vosges), M. Emile Dollfus (of Mulhouse), and M. Schneider, ex-minister, and now vice-president of its council. Under the management of M. Le Blanc, this school became the nursery of geometrical drawing, as it has been so well developed in the Schools of Arts and Trades, and in the technical schools of the country. The present professors of geometrical drawing at the Polytechnic School and the School of Bridges and Roads, as well as the School of Mines, and the Central School of Arts and Manufactures, were all taught by Le Blanc at the Conservatory.

Spinning school.

In 1810, when the continental blockade almost entirely prevented the importation of cotton goods, and the Government was very desirous of developing the manufacture of cottons, Chaptal established a spinning school at the Conservatory. Looms were also put up, in the old church of the abbey, for the purpose of instructing weavers, who afterwards found employment in private manufactories. This weaving school, though essentially a temporary institution, and having a character foreign to the more general object of the Conservatory, was discontinued after it had trained a sufficient number of workmen to give an impulse to the trade.

Commencement of public teaching.

We thus see that, with the exception of the elementary drawing school and this temporary workshop, the Conservatory had not, down to this date, any other object than the forming of collections, open to the public, of models of the machines, looms, and apparatus employed in the industrial arts. The functions of demonstrator have in reality never been fulfilled in the proper sense of the word, for the very simple reason that explanations given on the spot, in galleries open to a promiscuous crowd of visitors, were well nigh impracticable. No such demonstrations have therefore ever been given, and at the present day, when these galleries are sometimes frequented by 2,000 or 3,000 persons in the course of the day, they are so inconveniently crowded, that the impossibility of permanent demonstrations becomes still more

manifest; nevertheless, whenever explanations are solicited, from any motive more elevated than mere curiosity, the officials of the establishment are always ready to give them.

But what cannot be done in these crowded galleries is accomplished with ever increasing success in the amphitheatres; these were first opened in 1819 for instruction in the applied sciences, which has received the successive developments hereafter described. A royal Ordinance, dated 5th May 1817, appointed for the direction of studies at the Conservatory, a council of improvement which was presided over by an inspector-general, (the first president was the Duke de la Rochefoucauld-Liancourt, afterwards Duke de Doudeauville,) and of which the director and 12 other gentlemen eminent in science and art were members. This council was to give its advice on all matters and make any suggestions which it thought calculated to extend and multiply the advantages that the Conservatory of Arts and Trades was capable of conferring on the national industry, and especially on the means of securing to every branch of the establishment the greatest possible degree of perfection. Another decree, of the 25th November 1819, followed by a ministerial decision of the 2nd December, appointed the council as follows:—Duke de la Rochefoucauld, peer of France, *president;* Count Berthollet, Count Chaptal, M.M. de Mirbel, Gay-Lussac, Arago, Molard, Members of the Institute; M. Ternaux, manufacturer; M. Darcet, inspector of the Mint; M. Scipien Perrier, merchant; M. Widmer de Jouy, manufacturer; M. Welter, manufacturer.

Such was the scale of the institution in 1819. Limited to collections for the increase of which very scanty sums were allowed, no longer receiving models of newly invented machines and apparatus, and having never been able to organize the service of its official demonstrators, it only offered to industry a mute museum, from which the manufacturer or artisan might doubtless derive useful instruction, but altogether isolated from the principles which should form its base. The authors of the decree of November and the ministerial decision of December 1819 were well aware of this fact, and they therefore decided on establishing at the Conservatory a public and gratuitous course of public instruction on the application of the sciences to the industrial arts. This instruction, which was founded chiefly by the enlightened efforts of M. C. Dupin, at first comprised only three courses:—A course of mechanics and a course of chemistry applied to the arts, and a course of industrial economy. The first professors named were MM. C. Dupin, Clément Désormes, and J. B. Say. They were thenceforth allowed the same salary and privileges as the professors of the College of France and of the Museum of Natural History.

Decree of 1820.

In 1820, a royal decree for the regulation of the Conservatory of Arts and Trades declared:—

"Art. 1.—The Council of Improvement (*Conseil de perfectionnement*) of the Royal Conservatory of Arts and Trades shall be re-constituted under the name of *Council of Improvement of the Conservatory and Schools of Arts and Trades.*"

"Art. 7.—The Council of Improvement shall deliberate on the system of instruction and of work, on the sale of the products of the Royal Schools of Arts and Trades, and on the regulations and programmes made or to be made. It shall in the first instance take cognizance of the regulations at present existing, and shall present a special report on the maintenance of the same or on the modifications that may be deemed advisable."

"Art. 8.—Every year the Council of Improvement shall draw up a general report on the state of the Conservatory, and of the instruction there given, and shall present observations on the reports sent in from the School of Arts and Trades, which our minister shall have communicated to it. This report, with the accompanying observations, shall be presented to our Minister of commerce and Manufacrures. The result shall be submitted to us."

Decrees of 1829 and 1836.

For several years, and till 1832 or 1833, the council did indeed devote its attention to the different questions relative to the schools of arts and trades, but in a somewhat perfunctory manner, and without taking any real and continuous action. The application of the physical sciences becoming every day more extensive, a course of physics applied to the arts was considered absolutely necessary; it was founded by a decree of 1829, and thus added fresh popularity to the courses of the three first professors, which were already very numerously attended. Another decree, dated 25th August 1836, made three additions to the instruction already given; they were:—A course of cultivation; a course of mechanics and building applied to agriculture; and a course of agricultural chemistry.

Decrees of 1839 and 1840.

But the seven courses thus established were still insufficient for the increasing developments of industry and for the general demand of more scientific instruction; consequently in 1839 another royal decree, dated 26th November, founded five new public and gratuitous courses, viz.:—A course of mechanics applied to industry; a course of descriptive geometry; a course of industrial legislation; a course of agriculture; a course of chemistry applied to the arts. The course of cultivation, some few days later, was constituted a second course of agriculture, and the number of courses was thus raised to ten.

A royal decree of the 24th February 1840 modified the organization of the Council of Improvement, which thenceforth was composed of the professors only, without the co-operation of other members. From this time the Council of the Conservatory ceased to exercise the control over the schools of arts and trades which had been attributed to it by the decree of 1820.

Regulations of 1843.

On the other hand, the council was directed to present to the minister a draught of regulations both for its own interior organization and for the conducting of the public courses, as well as for the preservation, increase, and publicity of its collections. These regulations, approved on the 1st December 1843, were drawn up on the basis adopted for the College of France and of the Museum of Natural History. In conformity with the practice of those establishments it was decided that in case of a chair be-

coming vacant the new professor should be chosen from two candidates, designated, one by the institute the other by the Council of Improvement.

At the same time that the regulations of 1843 thus assimilated the Conservatory to our great scientific establishments, they also deprived it of the direction of the studies in the schools of arts and trades.

Project of 1848.

But in 1848 necessity and expedience superseded the regulations. On the one hand, a decision of the Minister of Agriculture and Commerce, considering that, "though the system of national "education is liberally organized for primary and secondary in- "struction in letters and science, the case is very different as "regards the teaching of the sciences applied to industry," charged the professors of the Conservatory of Arts and Trades, united in a commission, to organize a general system of teaching the applied sciences, and decided that the courses of the Conservatory should henceforth form the higher degree of that instruction.

A report on this important question was drawn up by the council and presented to the minister; but the events that supervened prevented the immediate accomplishment of those changes which the progress of French industry already demanded at that time. Moreover, from 1848 to 1855, several professors of the Conservatory were successively charged to inspect the Schools of Arts and Trades, as well as to revise their regulations and programmes. Lastly, the competitions for vacant masterships in those schools came regularly, held at the Conservatory, and several of its professors are always on the jury. In fact, it is difficult to conceive that all the questions relative to teaching in the Schools of Arts and Trades can be better discussed and solved by any other authority than the Council of Improvement, which, as now organized, is composed, in addition to the 14 professors, of ten members selected from among the most eminent manufacturers.

In 1848 a ministerial decision created a course of ceramics at the Conservatory, which the Director of the Sèvres manufactory was to give; but after the death of M. Ebelmen these lectures were not continued by his successor, though the course, till then given gratuitously, has not been officially suppressed.

New courses founded.

A decree of the 13th September 1852 added two new courses to those already existing. They were founded at the instance of the Paris Chamber of Commerce under the title of Course of Spinning and Weaving, and Course of Dyeing, Printing, and Dressing of Tissues. Another decree of the 30th November 1852 added a course of zoology applied to agriculture and industry, and in November 1854 a course of civil architecture was also founded, which raised to 14 the number of gratuitous public courses in the applied sciences now professed at the Conservatory. On the death of M. Blanqui, who had succeeded J. B. Say in the chair of industrial economy, the views then in the ascendent induced the ministry to transform that course into one of industrial administration and statistics.

Increase of the collections.

At the same time that the oral teaching was thus extended that which the industrial public can acquire from the examin-

tion of models and machines, as well as from observation and experience, received no less important augmentations. All the collections had been classified, since 1849, in methodical order; a complete inventory and a catalogue had been made, and every object exhibited is now accompanied by a card explaining its use.

Gallery of experiments.

A gallery of experiments and of machines in motion, the plan of which had been prepared as long ago as 1849, has been completed in the old church; reservoirs of water in the tower, and two steam engines, together of 30-horse power, serve to keep in motion a great number of hydraulic machines and machine tools.

Service of experiments.

But this gallery has a still more important use; it serves the purpose of trying, either at the demand of the different ministries, or of private manufacturers, the new machines and apparatus presented to the Conservatory for examination. Reports, stating the results of the experiments, which are usually made in the presence of the inventors, are drawn up, placed at the disposal of the public, and even published, almost entire, in the *Annales du Conservatoire*. This important branch, which has not been forced on the executive by any superior order, but has been organized solely in the interests of industry, has been in operation ever since 1852.

Except the expense of the installation, the trials are made gratuitously, and more than 200 reports have already been drawn up, not one of which has ever given rise to complaint, a fact which clearly proves the care and impartiality with which the experiments are conducted. The Conservatory also undertakes the verification of the standard weights and measures required by the foreign governments which have successively adopted the French metrical system.

Library and collections of drawings.

To the new galleries of models, which with the old ones are worth above 1,300,000 frs., must be added the library, containing more than 18,000 volumes of works on the sciences and industrial arts, and the gallery of drawings, in which more than 7,000 designs, of the most useful and newest machines, to scale and with dimensions given, are collected and placed at the disposal of the manufacturing world. Here also are kept the collections of expired patents, which may at any time be inspected by the public.

The universal exhibitions have enabled the Conservatory to obtain new machines, models, and drawings. Extraordinary credits, placed at the disposal of the director in 1851, 1855, and 1862, and the munificence of French and foreign manufacturers, have now so increased these scientific and industrial riches that the galleries are too full to admit of more additions. The consequence has been that in proportion as the collections increased, and the teaching was developed by the addition of new courses, the inadequacy of the buildings became more and more felt. The plan of enlargement adopted in 1842 had not been fully executed when it was discovered to be insufficient. In the year 1850 the Emperor, then President of the Republic, honoured the Conservatory with his first visit, and soon afterwards decided

on adopting a far more complete project, the execution of which, for divers reasons, was not commenced till 1862.

Museum of industrial art demanded by designers.

As early as the time of the London Universal Exhibition in 1851, our industrial artists, alarmed by the extraordinary efforts England had determined to make to dispute with France the sceptre of taste, demanded, as they do now, that a museum and centre of studies should be created in France for art applied to industry. Responding to this desire of the industrial interest the director of the Conservatory, in a memorial addressed to the Emperor in 1854, expressed himself as follows :—

" After a first visit to the Conservatory in 1850 your Majesty was pleased to command that a special bill should be presented to the Legislative Assembly for the completion of the works of enlargement already begun, and a credit was demanded for the purpose ; the financial difficulties of the moment, however, caused this project to be postponed. Since that epoch the Universal Exhibition of London has proved to England the superiority of France in the arts dependent on taste, form, and colour. Instead of disputing the fact the English have at once set to work, with their immense resources and habitual energy, to found museums and drawing schools all over the country. The Queen and private individuals have stripped their galleries to enrich the museums of practical art with the finest specimens of Sèvres porcelain, bronzes, scultures, &c. In England primary teachers are now compelled to learn drawing, that they may be able early to habituate children to the rules of *form* and *colour*.

" It would seem as if the English were bent on operating on the human species as they have on races of animals, so as to transform a nation of traders and artisans into a nation of men of taste. How far the Anglo-Saxon race is susceptible of this transformation is a philosophical question beyond *my province* ; but one thing is certain, namely, that a few years hence *England* will have made immense progress in the arts of design. In France, on the contrary, narrow views of cheap production constantly tend to the degradation of art, and if a great establishment, combining some of the most perfect types and models of ancient and modern art with methodical teaching be not available constantly to revive and correct taste, there will be reason to apprehend a decline.

" Your Majesty has already been solicited by the ablest of our artists to found a great school of drawing at the Conservatory of Arts and Trades, and thus to realize the idea conceived in the beginning of the present century by the Emperor Napoleon *I*."

The apprehensions expressed in this letter, as far back as 1854, were confirmed by the reports of several members of the jury at the Universal Exhibition of 1862, and they now proclaim the urgency of regaining the time lost in this respect. Almost at the same date the Paris Chamber of Commerce expressed a similar wish in a letter addressed, on the 30th January 1854, to the Minister of Agriculture, Commerce, and Public Works, to the effect that "great advantages would accrue from the opening of a " museum of industrial designs and models of ornament at the

"Conservatory of Arts and Trades, as well as from the construc-
" tion of halls sufficiently spacious to receive the pupils who
" might desire instruction."

Appointment of a commission of general organization of industrial education.

On the 17th February 1860, the director of the Conservatory, accompanied by M. Schneider, Vice-President of the Council of Improvement, made an application to the Minister of Agriculture, Commerce, and Public Works, for the appointment of a commission charged to present, as early as possible, a general plan of organization for teaching the sciences and arts applied to agriculture and industry. The minister of the day, M. Rouher, at once admitted the principle of the proposition, declared that it harmonized too well with the views of the Emperor's Government not to be immediately followed up, and that it was one of the logical and necessary consequences of the position in which French industry would thenceforth be placed. Though more urgent affairs have delayed from day to day, till June 1863, the appointment of the existing commission, the directors of the Imperial Conservatory of Arts and Trades cannot but feel proud of having done their utmost to attain the end in view.

In 1862, after the London Universal Exhibition, the director and sub-director of the Conservatory, in reply to an appeal made by the Imperial Commission, which had called upon the members of the jury to point out all the measures to be adopted in the interest of our industry, presented a special scheme for organizing technical education in France by utilising and connecting existing institutions.

After stating at length the origin and progress of the Conservatory of Arts and Trades, as well as the efforts perseveringly made by its director and council to carry out its regulations, which give it (Art. 17) "the mission of expressing an opinion on the " organization of industrial education, and on the means of making " the lectures and institutions of the Conservatory more and more " useful for the progress of industry," it will be appropriate to indicate the results obtained by the 14 courses which constitute the public and gratuitous teaching of science applied to industry at the Imperial Conservatory of Arts and Trades.

Results of the lectures.

The yearly reports addressed to the Minister of Agriculture, Commerce, and Public Works, show that the number of persons attending the public courses of the Conservatory is constantly increasing. In the year 1862-63, from November to the end of April, the auditors for all the courses and lessons amounted to the enormous number of 176,829, notwithstanding the absence of two professors owing to illness. The great amphitheatre of the Conservatory will accommodate 700 persons, the small one 360 persons, and they are often insufficient.

When these courses were first started, Sunday appeared to be the day preferred by the public; but as the instruction given came to be more appreciated, the attendance on the weekday evenings became more numerous, and there is good reason to prefer those sittings to the Sunday ones, at least for continuous lessons. Another circumstance which must not be forgotten is that the winter season is better for the evening lessons than either spring or autumn. When the days get long the workshops keep open

later, and then the studious youth and foremen who are there employed cannot get to the lecture room in time. The consequence is that every year regularly in the month of April the number of hearers undergoes a great diminution. This result, which is also noticed with regard to lectures given elsewhere, indicates that, as a general rule, public courses ought to be generally held in winter.

Peculiar difficulties of the teaching.

The oral teaching of the Conservatory of Arts and Trades is exclusively devoted to science applied to industry; it addresses an audience for the most part composed of apprentices, foremen, and workmen already instructed; but besides these there are also some few foreign professors and many persons who take an interest in the progress of technology. These public and gratuitous courses thus open, with a liberality truly French, to both natives and foreigners, constitute a free instruction analogous to the lectures at the Sorbonne, the College of France, and the Museum of Natural History. Its object is rather the applications of science than science itself properly so called; but it must nevertheless advance *pari passu* with the latter, and the unequal character of the audience to whom it is addressed involves a special difficulty for the professors much greater than may be generally supposed.

To expound the principles of descriptive geometry and of mechanics, as well as their applications, without having recourse to scientific formulæ of an order too high for the generality of the hearers; to deduce from a few general elements and observed facts the laws of natural phenomena, and thence infer the rational processes to be followed in the practice of the arts; to render strictly scientific instruction intelligible to the average mind in a simple manner without using calculations or reasoning too hard to comprehend;—these are difficulties of which scientific adepts who have never made the experiment can have little conception. This, however, is a condition that must be satisfied under pain of falling into a mode of teaching without fixed principles, or into one, equally injudicious, of too dogmatical expositions, bristling with calculations and formulæ which would drive away hearers unprepared to receive them or already engaged in the actual practice of their trades. Such of the professors as have been attached to the Polytechnic School, to the schools of application for artillery and engineering, to the Central School, &c., where the professors can join to the simplest methods all the scientific resources of the highest order, have unanimously acknowledged, from their own experience, how much more difficult it is to teach in a clear, simple, and rigorous manner at the Conservatory than in the establishments above mentioned.

To this difficulty, which certain courses cannot altogether escape, must be added, at the Conservatory, that of keeping the instruction on a level with all the improvements constantly being made in science and its applications, as well in France as abroad. In this respect, and owing to this necessity, the lectures here given are among the most progressive in the world; this fact is so well known that they are attended by a great number of young foreigners of all classes, and especially by young men who are preparing to become professors.

The influences brought to bear on the progress of science applied to industry by the Imperial Conservatory of Arts and Trades may thus be summarized :—Collections of models, machines, and products. Lectures on science applied to the arts and to industry. Appliances for experimenting. A library, composed of 18,000 volumes on science and industrial art. A gallery of designs placed at the disposal of the public for taking copies; and an elementary school, which would become far more useful if transformed into a special high school of art applied to industry. Summary.

This is not the place to enlarge on the greatly increased influence this establishment might be called to exercise on the general direction to be given to the methods of teaching, whether for the sciences or the industrial arts; the inquiry now making by the Commission, and the discussions to which it will give rise, may lead to the conferring of still more important functions, and we will therefore merely say that, without soliciting them, the teaching staff of the Conservatory will not shrink from any new duties that may be imposed on them.

The existing organization of the Conservatory is determined by the Imperial decree of 10th December 1853, and its budget is fixed by the finance laws. The sum at present voted for it amounts to 285,500 fr. a year.

A. Morin, *Director.*
Paris, 3rd April, 1864. A. Tresca, *Sub-Director.*

Account of the Central Imperial School of Arts and Manufactures.*

Object of the School.

The Central School of Arts and Manufactures, founded in 1829 by three then youthful votaries of science, MM. Dumas, Péclet, and Ollivier, aided by M. Lavallée, who zealously co-operated in the work, is not yet so highly appreciated as it ought to be. It plays, without any parade, a most important part in our educational system—a part still underrated by a great number of persons. It has quietly rendered signal services and is destined to render still greater—a fact we will endeavour to demonstrate. Foundation of the Central School.

In 1829 manufactures, thanks to several years of profound peace, were beginning to assume great importance in France ; but to struggle against foreign competition, daily becoming more formidable, it was not enough to possess good workmen and intelli- Its object.

* Part of this notice has been borrowed from the prospectuses of the Central School, and especially from the account of the proceedings of the founders during the year preceding its opening, in which the principles of this institution are affirmed and all the details of execution laid down.

gent overseers, skilful engineers were likewise wanted. The manufacturers, moreover, felt the necessity of themselves acquiring or of obtaining for their children that theoretical knowledge without which they were unable, not only to direct their establishments themselves, but also to control the managers whom they engaged for the purpose. At that time there was no school where industrial science could be acquired.

Comparison between the Central School, the Sorbonne, the Conservatory of Arts and and Trades, and the schools of arts and trades.

The Sorbonne, the Conservatory of Arts and Trades, the schools of Châlons and Angers, though very useful institutions, answered the purpose but very incompletely. They did not impart that accurate and profound instruction which is necessary for the directors of large manufacturing establishments and indispensable for civil engineers.

At the Sorbonne and the Conservatory the teaching is purely oral, and the fact is indisputable that such lectures are *not* sufficient for the training of engineers. They can only answer that purpose when accompanied by frequent examinations, numerous experiments and manipulations, graphic studies, conferences on the subjects treated in the courses, varied projects, solutions of problems performed by the pupil under the professor's eye. These various modes of teaching must be combined to obtain the best possible effect. Compare the Sorbonne with the Polytechnic School; all the courses of the latter are found in *the Faculty* of Sciences, and nearly all of them are given by the same professors. Nevertheless the results of the teaching are very different in these two establishments. The Faculty of Sciences wants those frequent examinations, those regular and methodical studies which are imposed on all the pupils of the Polytechnic School. Reduced to its lectures only, the Polytechnic School would soon lose its privilege of supplying France with men able to render the most important public services. Between the *Conservatory* of Arts and Trades, which is a real industrial Sorbonne, and *the* Central School the same comparison may be established as between the Faculty of Sciences and the Polytechnic School.

The Schools of Arts and Trades supply our workshops with young men who promptly become excellent overseers; but the theoretical studies are not sufficient to form skilful engineers. Some few remarkable men have indeed proceeded from these schools, but they were of the sort who will learn wherever they may be, and rise to celebrity just as well from the dust and smoke of the workshop as from the benches of a schoolroom.

The Central School, therefore, cannot be compared for the services it renders either to the Sorbonne, or to the *Conservatory* of Arts and Trades, or to the other technical schools. It remains to be seen whether it is not an unnecessary duplicate of its elder sister, the Polytechnic School, and this question we will now examine.

Comparison between the Central and Polytechnic Schools.

The Polytechnic School was founded at a time when political revolutions had thrown scientific studies into the background. Its object was to give those studies new life, to impart a common direction to the labours of scientific men, to concentrate on one point efforts till the nunconnected; in short, to supply our corps of

engineers, civil and military, with the well-taught recruits they so much needed. And it has nobly fulfilled its mission. The Schools of Mines, and of Bridges, and Roads completed the work undertaken by the Polytechnic School.

But the time required by the Polytechnic School, including the preparatory and complementary studies, is seven years, which is much too long for candidates who are anxious to begin practice as soon as possible. The difficulties of the examination for admission also exclude a large proportion of candidates; the consequence is that the number admitted every year is very limited. It shuts its doors against many hundreds of young men whose minds, though little disposed for mathematical abstractions, are none the less capable of studying the applied sciences. More than half its pupils choose the military service, and of the other half a good part soon abandon the civil services to follow scientific pursuits. The Polytechnic School is therefore far from being able to satisfy the ever increasing demands of industry. There is good reason to fear that if the pupils of the Polytechnic School were left free to choose between the posts offered by private industry and those reserved for them by the Government, the cleverest of them would give the preference to industry, which assures them positions, if not more honourable, at least more liberally remunerated; hence might result great prejudice to the State. The Government seems to be aware of this, for it has already forbidden its engineers to serve any other companies but those for railways.

Deficiency supplied by the Central School.

The Central School, therefore, supplies a manifest deficiency in our system of instruction. Its function is to educate our leading manufacturers, and the directors of our great industrial establishments; while the mission of the Polytechnic School is more especially to supply properly qualified recruits for the special corps. The success it obtained from the very first, a success every day increasing, sufficiently proves its immense usefulness.

Notwithstanding its high charges, and the fact that it does not, like the Polytechnic School, offer its pupils any assured position on the completion of their studies, the Central School has found, in presence of other establishments where instruction is gratuitous, the number of candidates for admission constantly increasing, and to such an extent that not more than half of them can be received. The late treaties of commerce have rendered industrial education more necessary than ever. "If the Central School did not "already exist," says M. Michel Chevalier, "it would have been "indispensable to found one as a necessary complement of those "treaties." Moreover, it is a tradition in the school that its foundation was originated with a view to preparing French manufacturers, by a sound education, to pass without any violent shock from a system almost prohibitive to one of limited protection.

Rank taken in all the branches of industry by the ex-

In all the branches of industry the pupils of the Central School have taken honourable positions. They stood in the first rank among the creators of railways, and some of them, notwithstanding the formidable competition of the Government engineers, still

pupils of the Central School.

hold important positions under the great companies. At Paris the chief engineers of the rolling stock and locomotive department of four great companies (the Northern, the Orleans, the Eastern, and the Western) belong to the Central School. In the mining and metallurgical industries, in those of gas, spinning, dyeing, paper making, plate glass manufacture, in the agricultural arts, and lastly in all the mechanical and chemical industries, we find at the head of large establishments old pupils of the Central School, who have nearly all attached their names to important improvements in the processes they were charged to conduct.

The above statement is fully proved by the following figures:—of the 2,051 pupils who obtained on leaving the school the diploma of engineer or the certificate * of capacity we have been able to obtain precise information respecting 1,394 only. Of this last number we learn that 247 are dead, and that the 1,147 still living are distributed in different careers in the following manner:—

Railways:—Directors and chief engineers, salaries from 20,000 to 70,000 fr.	28	320
Principal engineers, salaries from 10,000 to 20,000 fr.	79	
Ordinary engineers, salaries from 5,000 to 10,000 fr.	56	
Employed in various capacities	157	
Civil engineers in general practice	166	
Ironmasters, working of mines, quarries, &c.	124	
Manufacturers of cloth, cotton, linen, &c.	68	
Architects	55	
Mechanical engineers, established	54	
Spinners	43	
Professors of applied sciences	42	
Manufacturing chemists	38	
Agriculturists	37	
Contractors for public works	35	
Managers of gas works	31	
Sugar refiners	28	
Public functionaries	26	
Manufacturers of glass, porcelain, &c.	23	
Engineers of bridges and roads in foreign countries	22	
Paper makers	17	
Surveyors of roads	17	
Total	1,156	

Number of crosses and medals obtained at

The number of crosses and medals obtained by ex-pupils of the Central School at the great international exhibitions is one of those facts which prove their merits better than arguments.

* The diploma is granted to those pupils who pass every part of the examination satisfactorily; the certificates to those who answer some of the questions well, but fail in others.

In 1851 the Central School was too recently founded for many of its pupils to have had time to take their ranks in manufactures. The English Commission having besides refused rewards to assistants (*collaborateurs*), several of the ex-pupils could not be personally named, though the establishments they managed obtained prizes. Nevertheless they received three council medals and 17 prize medals. great exhibitions and agricultural shows by pupils of the Central School.

In 1855, at the Paris Universal Exhibition, they obtained 10 nominations in the Imperial Order of the Legion of Honour; 10 great medals of honour; 17 medals of honour; 50 first-class medals; 21 second-class medals; and 14 honourable mentions.

In 1862 the number of French exhibitors at the London Universal Exhibition was comparatively small, but the ex-pupils obtained three nominations in the Legion of Honour, one of them as officer, and 41 medals.

In the agricultural shows of 1856 and 1860 ex-pupils of the Central School were honoured with two great gold medals; three ordinary gold medals; two silver medals; four first prizes; and six prizes of the second, third, and fourth class.

The total number of ex-pupils who have obtained the decoration of the Legion of Honour, either after great exhibitions or on other occasions, is 56, of whom 52 are knights and four officers. Total of ex-pupils decorated.

Organization of the Teaching.

In organizing the Central School its founders took for their model the old Polytechnic School (Central School of Public Works), with the modifications required by the object they had in view. For instance, they excluded from the curriculum everything connected with mathematical theories of too high an order, experience having shown that the said theories have but few practical applications. The teaching of the Central School based on the same principle as that of the Polytechnic School.

At the Central School, as at the Polytechnic, the pupils are obliged, whatever may be the career they have chosen, to attend all the courses and to pass very strict examinations. The young men are thus prepared to follow almost any profession. It is, in fact, by no means unusual to see young engineers, on leaving this school, successfully pursue a different career from that originally chosen. At the Polytechnic School this generality of instruction extends to the theoretical studies only, since the pupils at the end of the three years' course are sent to one or other of the special schools to complete their education. At the Central School the instruction is purely theoretical in the first year only; in the second and third, theory and practice are blended.

The founders of the Central School justly remarked in their first prospectus:—"All the courses of the school really form but "one and the same; industrial science is one; every manu- "facturer must know the whole under pain of being inferior to "the rival who enters the lists better armed than himself. Arts "apparently widely differing from each other make use of "analogous operations, yet often employ very different methods. "The general education of the Central School teaches how to Unity of industrial science.

"transfer into each process of manufacture the improved "methods used in others. It consequently tends to introduce "into industrial establishments, and into the details of the "processes or of the mechanisms, a degree of perfection which "secures the harmonious working and general success of the "whole." This was a noble and prolific thought; it has produced abundant fruit.

Qualifications required by the studies of the Central School.

The studies of the Central School and those of the Polytechnic School require very different qualifications. Though some of the pupils of the Central School have shrunk from the difficult tests required by the Polytechnic, we have good reason to believe that among the pupils admitted to the latter there are some who would not have succeeded at the former. The pupils who, after preparing for the Polytechnic School, enter the Central School, usually take the lead of their comrades in the first year, but often fall behind them in the second and third. The consequence is that the establishments which prepare pupils for the scientific and industrial schools have felt the necessity of adopting a special mode of preparation for the Central School.* Again, the council of the Central School, which at one time used to admit for the second year's studies candidates who were able to pass a satisfactory examination on the subjects taught in the first, now require that every pupil shall go through the complete course in the school. Experience has clearly shown that the instruction acquired elsewhere than at the school can scarcely be a suitable preparation for the courses of the higher divisions, which are based on what the pupils have been taught during the first year.

Preparation for these studies.

Summary of studies.

The studies of the Central School may be thus briefly recapitulated:—

In the first year pupils follow the course of descriptive geometry with applications; analysis, comprising the elements of the differential and integral calculus; cinematics, general mechanics, general physics, general chemistry, construction of machines, and hygienics.

In the second and third year courses of applied mechanics, construction and putting up of machines, analytical chemistry, industrial and agricultural chemistry, constructions (civil buildings, public works, and railways), applied physics and steam engines, metallurgy, mineralogy, geology, and working of mines.

The course of construction of machines, which is very complete, as well as that of applied physics and steam engines, and the course of applied chemistry are peculiar to the Central School. The teaching of mechanics is also conducted on a new plan, in a spirit essentially practical.

Programmes of the courses.

An accurate idea of the education given at the Central School may be formed from an attentive study of the new programmes (an abstract of which is given further on). Whoever reads them will admit that if they have not yet reached perfection, they nevertheless present a well-ordered instruction useful to all who wish to pursue an industrial career.

* In 1864, out of about 400 candidates who competed for admission to the Central School, only 50 had prepared for the Polytechnic School.

Reform of the instruction.

An important reform is in preparation, with the assent of the Minister of Public Works, in the general organization of this school, which must necessarily lead to some few changes in the programmes of each course. These modifications may be summarily stated as follows :—

Ever since the first foundation of the Central School most of the courses for pupils of the second and third years, being of two years' duration, were given by one and the same professor to the pupils of the two divisions at once. The course was divided into two sections, each composed of a nearly equal number of lessons, and the pupils of the second year began alternately with one or the other section. This mode of proceeding had the advantage of economy, but was attended with very serious inconveniences. For *instance*: 1. The pupils were not all equally well prepared for the lessons given to them, those of the third year being more advanced than those of the second. 2. The ideas were not always presented in their logical order; the course of metallurgy, for instance, was begun one year with the theory of blast furnaces, and the next with that of forges. 3. The number of examinations imposed on the professors at the close of their courses, as well as of the exercises to be corrected, was excessive. 4. The number of pupils of the two divisions united was too great to be accommodated in the largest amphitheatres of the school, none of which would hold above 300.

In future the courses, according to the new organization proposed to the Minister of Public Works, and approved by him on condition of the school budget being sanctioned by the Legislative Body, will be divided into two, and given to each division by different professors. This, of course, considerably increases the expense, but will secure a great improvement in the teaching, and allow of admitting a larger number of pupils to the school.

Studies of projects, exercises in the laboratory, &c., completing the oral courses.

The oral instruction of the Central School is judiciously completed by imposing on the pupils numerous studies of projects, by manipulations in the laboratory, by visiting workshops, by mineralogical and geological excursions, and especially by frequent compulsory examinations, not only at the end of each year's studies, but also during the courses and at their close. The pupils, in drawing out projects and in chemical manipulations, begin to apply what they learn in each course, and thus prepare for the more serious operations of practice.

Numerous examinations.

The numerous examinations, one at least every week, have an excellent effect in keeping the pupils always up to their work. When a falling off appears in the marks obtained at the examinations, the director recommends the pupil to be more diligent, and, if necessary, summons him before the council of order, composed of the director, the sub-director, the director of studies, and a professor or a member of the school council. The pupil is also cited before the council if he commits any breach of discipline, such as being noisy in the class-rooms or amphitheatres, refusing to obey, &c., or if he be frequently absent without reasonable cause. If a pupil does not heed the friendly advice of the council of order, he is called before the school council and

more or less severely reprimanded. Any pupil found incapable of following the courses with profit is requested to leave the school, and if he refuses he is struck off the lists, after the minister's approbation has been secured. The pupil who persists in disorderly behaviour is liable to expulsion.

Accounts kept of marks and notes.

For every pupil an accurate account of his examination marks and notes of conduct is kept in a ledger reserved for the purpose, and extracts therefrom are sent to parents when requested. These notes are useful not only as enabling the superiors of the school to form a correct judgment of each pupil's progress and conduct, but they also play a very important part when, on the pupil's leaving the school after completing his studies, the council of professors has to decide on the terms of the certificate he deserves.

Influence of the examination marks of second and third year on the results of the final competition.

At first the council of the school, when definitively classing the pupils according to their merits, took into account only the marks obtained at the final competitive examination at the end of the third year, when each pupil had to present a project on a given subject. But experience soon showed that a pupil who answered correctly the questions put at the examination was not unfrequently a very indifferent pupil favoured by a lucky chance. It was therefore decided that the average marks of the third year should be added to those of the competition in appreciating the merits of the candidate. As pupils were often found to be somewhat negligent in the second year, it was subsequently deemed advisable to carry this principle still farther and take into account the marks of the second year in awarding the diploma or certificate of capacity, and in assigning the pupil his place in the list published in the *Moniteur*. With all these precautions, it is scarcely possible that there should be any great mistake in appreciating the merits of the pupils.

Value attributed to the diploma by manufacturers.

This fact seems to have been well understood by manufacturers, for most of them require candidates for employment to produce either a diploma or certificate, and as the latter is of less value than the former, we every year see old pupils who have obtained certificates only, present themselves again to compete for the diploma.

Number of diplomas and certificates obtained.

In order to show the proportion of diplomas or certificates granted as compared with the whole number of pupils, we have gone over the registers of the school, and find that out of every hundred pupils admitted:—

	Obtained Diplomas.	Certificates.	Diplomas or Certificates.
In 1829 (first year)	13	7	20
1831	23	10	33
1835	29	14	43
1840	25	13	38
1850	40	16	56
1855	30	12	42
1857	36	20	56
1859	46	15	61
1860	50	17	67

The number of diplomas and certificates has perceptably increased during the last few years, although the examinations are more severe than formerly; this increase is owing to the greater strictness of the examinations for admission, which can be successfully passed only by pupils who possess considerable talent and have made good use of their previous opportunities. It is easier to get admitted to the Central School than to the Polytechnic, but far more difficult to obtain a diploma there than to leave the Polytechnic with a place under Government. At the Polytechnic School the number of pupils who fail at the examination on leaving seldom exceeds two or three per cent. Increase in number of diplomas.

The number of pupils admitted to the Central School in its first year (1829) was 147, but it fell to 45 in 1832, during the prevalence of the cholera, and has kept almost constantly increasing since. In 1840 it was 125; in 1845, 152; in 1855, 220; and from 1855 to 1863 it has ranged from 200 to 220. This last number is a limit we have never attempted to exceed, owing to want of room and other reasons. Nothing can so well demonstrate the excellence of a mode of teaching as the results obtained, and these we have set forth as clearly as we could. Number of pupils admitted.

For some few years past the pupils of the Central School have found more difficulty in obtaining employment, either owing to the languid state of manufactures arising from various well known causes, or to an excessive supply of candidates, as for situations on railways for instance. But a friendly association of ex-pupils was founded in 1862, which now counts 1,260 members, and has amassed a capital of 60,000 frs. Its object is to bring the school to the notice of manufacturers, to show them what services it may render, and thus aid the pupils in finding profitable occupation. The association has already produced good results, and when it shall have more widely extended its operations, will doubtless be still more serviceable. The number of occupations for which the pupils are well fitted is immense, but many branches of industry in which they could take part have not yet had recourse to their co-operation. When more widely known and better appreciated they will find employment for their talents to the advantage of the country as well as their own. Association of ex-pupils of Central School.

Being convinced that the Central School only requires to be more extensively known, we have diligently sought for means to bring it more prominently before the public. One of the best appeared to be the opening of the spacious halls of the school for evening receptions during the winter season, and inviting the attendance of persons eminent in the manufacturing, scientific, commercial, and political worlds, as well as the professors of the school, ex-pupils residing in Paris, and also a certain number of the present pupils. To render these parties attractive, we not only obtained the assistance of our first artists, but we also prevailed on some of our most distinguished experimenters, as Ruhmkorff, Dubosc, &c., to repeat in one of the halls some of the newest and most remarkable experiments in physics, and we likewise exhibited the most approved instruments and apparatus for the gratification of our guests. Such parties cannot, of course, Evening receptions for the purpose of popularizing the Central School.

be given without considerable expense, but we thought they would be very advantageous for a school which has to find places for 100 pupils every year, and that a credit ought to be opened to our successors that they may be able to continue to do as we have done.

It may, perhaps, be objected that there is no vote for expenses of representation in the Schools of Mines and of Bridges and Roads; but it must be observed that the number of pupils in those establishments for whom places have to be found (the outdoor pupils only) is very limited compared with that of the Central School, and that the permanent existence of those schools is secure, as their chief function is to educate engineers for the Government, and as their receiving of outdoor pupils is optional and regarded as a favour. In the schools of law and medicine the position is likewise different; the youth who leave those schools have not to seek for a situation before they can begin to practise what they have learned.

Comparison of the organization of the teaching at the Central School with that at the Polytechnic Schools of Germany and Switzerland.

It is interesting to compare the system of teaching at the Central School of Arts and Manufactures with that at the Polytechnic Schools of Germany and Switzerland. We will endeavour to make this comparison as concisely as possible.

The Polytechnic Schools of Germany and Switzerland (Hanover, Brunswick, Berlin, Dresden, Prague, Vienna, Munich, Stuttgart, Carlsruhe, and Zürich), are real technical faculties. The Zürich school is even more than that, since it has courses of political science, &c. The number of courses is considerable; they are extremely varied, and for the most part professed by very learned and talented men.

The pupils of all these schools are in no instance lodged and boarded on the premises. They are subdivided into auditors, or pupils who attend only such lectures as they choose, and regular pupils, who are obliged to attend a certain series of courses constituting a complete technical education, such as is required for builders, mechanicians, chemists, &c.; they also have to perform certain practical exercises in the chemical laboratory and workshops; in some places (as at Dresden and Berlin, for instance,) they have to cease their theoretical studies for a time and leave the school to work under practical men, before they can enter on the concluding portion of their instruction at the schools. None of these Polytechnic Schools, except that of Zürich, grant diplomas to their pupils.

If we compare the programmes of these schools with that of the Central School, we shall find them very much alike as regards theoretical teaching; but as to applications a great difference exists.

The examinations on admission are much less formidable in the German schools than those which the pupils of the French Polytechnic School, and even those of the Central School, have to pass. When admitted, the pupils enjoy much greater liberty than in the last-named schools, and have not to go through so frequent examinations.

Lastly, the pupils are obliged to attend only those courses which relate to the profession they have chosen. At the Zürich school the *discipline* is nearly the same as in our schools, but, as in Germany, the pupils are not compelled to follow any courses but those of their specialty.

The question may fairly be asked whether the severe examinations imposed on the pupils of the Central School before their admission and during the studies are really useful. We are fully convinced that they are beneficial, and are persuaded that sooner or later they will be also imposed in the German schools as they have already been at Zürich.

In some of the German schools, and at Zürich, the professors are occupied a great many hours. In France, on the contrary, they give only a small number of lessons, so that they have time for *practical studies*. Although the discoveries which a theoretical professor may make in pure science greatly contribute to the dignity of his teaching, the factories, machines, and works of art which a professor of the applied sciences has produced, have an influence equally great on his pupils. The confidence of the auditory is proportioned to the estimate in which the professor is held by public opinion, and this is always measured by the service rendered or the impulse given to the ideas of the time. The Central School has always been most careful to choose professors whose authority doubles the force of their words and the fruit of their lessons.

Admission of Foreigners to the Central School.

Many foreigners are admitted to the Central School.

The Central School is distinguished from the other French professional schools and from the Polytechnic, inasmuch as it admits pupils of *all* countries on the same footing as the natives of France. It is truly an international and cosmopolitan establishment. The number of foreign pupils has been and still is considerable. In Spain, Holland, and Italy they occupy high political and industrial positions. In Belgium they took an active part in the establishment of the first railways and have attained high positions in industrial enterprises, especially in those connected with mines and metals. In Switzerland they play an important part; England, Germany, Russia, Poland, Italy, Holland have given us excellent pupils. The United States, Mexico, the South American Republics, Brazil, Egypt, and even Indo-China have sent pupils to the Central School.

Comparison of the numbers of French and foreign pupils.

The following table will give a correct idea of the number of foreigners who had been educated at the Central School up to the 1st of January 1864; the total of pupils admitted was 4,560; of this total there were 1,114 foreigners thus distributed among the different nations:—

Switzerland	162
Poland	117
Germany	114
Spain	104

West Indies	88
Belgium	[illegible]
Italy	65
Great Britain and Ireland	58
United States of America	53
South American Republics	47
Russia	37
Brazil	36
Egypt, Mauritius, and Madagascar	34
Holland (from Luxemburg chiefly)	33
Mexico	32
Eastern provinces of Europe	19
Turkey	18
East India	14
Portugal	9
Total	1,114

Of these 1,114 foreigners, 441 obtained either the diploma or the certificate.

In opening its door to foreign pupils, who have amounted to about one-third the number of the French, the school not only consulted its own prosperity, but also adopted a patriotic course beneficial to France. No one can fail to see the advantage that must accrue to our country from the bonds of union formed between these young foreigners and their French companions during the three years' study, an intimacy often ripening into lifelong friendship.

Foreign Schools founded on the Model of the Central School.

Schools founded in foreign countries on the model of the Central School.

The Central School, like the Polytechnic, has been imitated in foreign countries. Several professional schools on similar bases have been founded in Belgium, Spain, Switzerland, and the United States. Some of them, though taking the more popular designation of Polytechnic Schools, have nevertheless adopted the system of instruction followed in the Central School. In Egypt, for instance, M. Lambert Bey established a polytechnic school, in which, by his own avowal, he adopted the programme of the Central School with some few changes to suit the habits and requirements of the country. In England, after the Exhibition of 1851, Prince Albert also thought of founding a great industrial school, which a report, drawn up under his auspices, alleged to be indispensable for maintaining English industry at the height it had attained. Dr. Lyon Playfair then proposed the Paris Central School as the best model for imitation, but Prince Albert's project was not realized.

Without disputing the merits of the schools copied from the Paris Central School, we feel confident that that establishment will retain its superiority, seeing that it is situated in the most learned city of the world, admirably placed for obtaining the se[illegible]

vices of the most eminent professors, in the centre of an intellectual movement unequalled elsewhere, and within reach of magnificent museums, as well as of first-rate manufactories of all kinds.

Future Prospects of the Central School, and its Influence on the Prosperity of the Country.

Manufacturers and heads of great industrial establishments whose sons have been educated at the Central School.

We have given an account of the constitution of the Central School, as well as of its proceedings down to the present time: let us say a few words as to its probable future. A considerable number of our most important manufactories are already under the direction of old pupils of the Central School, and their number is daily increasing. Many great manufacturers have likewise sent their sons to the school. On the lists of old or present pupils we find the following names, all of high standing in the industrial world of France: Bayvet, Binder, Biver, Bella, Blech, De Blonay, De Bussières, Cail, Cheilus, Clouet-Lacretaz, Chagot, Chameroy, Chevandier, Clémandot, Dailly, Darblay, Dervaux-Lefebvre, De Vendel, Dietrich, Dollfus, Dubied, Dufournel, Dufour-Martin, D'Eichthal, Farcot, Feray, Gast, Gouvy, Gros, Hamoir, Hartmann, Houel, Imbs, Jacquesson, Jourdain-Davillier, Koechlin, Laligant, Legavrian, Lemaître, Lespérut, Mertian, Montgolfier, Noblot, Pereire, Polonceau, Raspail, Rhoné-Pereire, Saglio, Sautter, Schlumberger, Schmerber, Sellières, Sieber, Seguin, Stehelin, Stoeklin, Sommier, Turckheim, Zoude, Zuber.

We have little doubt that this predilection will become general, and that ere long nearly all the most important industries of the country will be under the management of the ex-pupils of the Central School. What immense influence they will then exercise on the future of a country where manufactures play so important a part! Can there be any doubt that this influence will equal that which the pupils of the Polytechnic School have had on the progress of science?

Services rendered by the Central School in a political point of view.

In a point of view purely political the Central School is also destined to render great services. Its numerous relations with influential men in foreign countries cannot fail to draw closer the bonds which unite different nations.

Nor has it been without influence on public morals and on the tranquillity of the country. The number of young men who, after attending the courses of the schools of law or medicine more or less completely remain without any occupation, is enormous; and a few years back the commission of the budget complained of the floating population of those schools at the very moment when the council-general of manufactures was deploring, on the other hand, the small number of young men who enter on the career of industry with solid acquirements applicable to the different branches of production. These young men thus unable to find an opening for the exercise of their profession become a real danger to society, and think they have a right to complain of its indifference and neglect. Among the pupils of the Central School, which has opened its doors to many of these young waifs of law

and medicine, there are very few, on the contrary, who fail to attain positions more or less lucrative, more or less independent.

We wish it, however, to be clearly understood that although we attribute great importance to industrial enterprise, we *do not* agree with those who think that France is destined to become one great factory, as it were, in which every citizen should be a workman. In our opinion that would be a very wretched country in which the study of science should exclude the *cultivation* of letters, philosophy, and the fine arts; in which the mercantile spirit should extinguish everything that is great, sublime, or beautiful, but not practically useful.

The studies of the Central School have a greater influence on the moral sense than is commonly supposed.

It must not be imagined, however, that the studies of the Central School extinguish all the fires of fancy. They have a greater action than is supposed on the moral sense, and develop rather than deaden it. This fact would be unanimously affirmed by the council, which so often has opportunities of *observing* the reciprocal feelings of the pupils towards each other, whether in the school or later amid the struggles of life, and it is also well aware of the respectful affection felt by the old pupils for all *its* members, an affection of which they every day receive the most convincing proofs.

Objections against the Teaching of the Central School.

Absence of manual operations: difficulty of combining intellectual and manual labour.

We have now to reply to sundry objections which have been made against the teaching of the Central School.

It has been said that the pupils of the school ought to devote a part of their time, like those of the schools of arts and trades, to manual operations; that they would then become far more capable of managing workshops. (It is a mistake to think that intellectual and manual labour can be combined without inconvenience.) Experience has proved that they injure each other. *It is not* absolutely necessary to be able to perform every manual operation oneself in order to see that artisans do their work properly (and it has often been found that he who pays excessive attention to details neglects the general effect.) Should it, however, be deemed necessary to initiate a young man in the operations of the workman, let him, on leaving the school, pass a year or two in a good workshop, executing all kinds of work, and he will thus learn far better than by practising at school. Several pupils of the Central School have adopted this course with great success. Others pass through the Schools of Arts and Trades before coming to the Central School; these are in general excellent pupils, but are apt to be somewhat deficient in literary acquirements.

Impossibility of extending the circle of studies at the Central School.

The Central School has likewise been reproached with not imparting to its pupils certain kinds of knowledge which are regarded as very important by manufacturers, such, for instance, as the rudiments of industrial economy, keeping of accounts, general technology, foreign languages, &c.

Without disputing the advantage of acquiring these branches of knowledge, we must observe that the pupils' time is already so fully occupied that they cannot possibly be subjected to additional

studies in the school. They must complete their education in such matters after leaving. *They have acquired the art of learning*, but they are far from possessing, on leaving the benches, everything requisite for them. The instruction even which they receive in the courses necessarily leaves some gaps which they must fill up afterwards.

Some employers complain of the extravagant pretensions of our pupils on leaving the school. We certainly do not encourage anything of the kind. On the contrary, we always advise the pupils to be content at first with very humble posts, provided there be a prospect of their obtaining in due time positions worthy of the education they have received. Vanity is, however, a failing not uncommon among young men, and there is no ground for astonishment if our pupils are not free from such illusions. This defect gradually diminishes as they get older and come to know more of the world. The good pupils of the Central School are excellent instruments in the hand of those who know how to use them.

Dangers to which outdoor pupils are exposed.

The Central School, like the Schools of Medicine and of Law, receives only outdoor pupils, and the young men have, therefore, a degree of liberty out of school hours which has been thought dangerous amid the seductions of a large city. Experience has proved that no such danger exists, because they are subject to a discipline far more severe than our medical and law students; part of them live with their parents, and others lodge and take their meals at respectable boarding schools, with which the directors are in constant communication. Their studies, too, are for the most part so attractive that they captivate the greater number and preserve them from dissipation, at the same time training them to moral habits more effectively than precepts, which are so easily forgotten.

High charges of the school.

The terms of the school (800 frs. a year) have been thought too high, and a reduction recommended on the ground that the present charges exclude all persons of narrow means.

The school charges, with board and lodging added, are not higher for a pupil of the Central School, considering the duration of the studies, than for a student of law or medicine; and the former is far more likely, by means of his diploma, soon to obtain a good position than the young lawyer or doctor. It is nevertheless true that the sons of parents in very humble circumstances cannot incur the expense. But the Government and some of the departments have founded scholarships in favour of such persons, and have in some cases also given money for board and lodgings. The sons of rich parents, therefore, pay for their education, as they naturally ought, and the doors of the school are also open for the sons of artisans who have given proofs of the talent necessary to profit by the instruction. The number of scholarships is at present very limited, but we hope soon to see it increased.

Historical Retrospect and Conclusion.

The success of the Central School is a very remarkable proof of the power of private enterprise. In a few years, notwith-

standing the terrible ravages of the cholera in 1832, the Central School had so far prospered as to rank with our most useful institutions. It is really astonishing that such important results were obtained with so small a capital, the total outlay not having exceeded 200,000 fr.

It is only fair to state that the first professors joined in the enterprise with a zeal which the State would not, perhaps, have obtained; for many years they laboured indefatigably, and were content with a very moderate salary, considering the number of hours occupied and their high professional reputation. To this zeal for the prosperity of the school, to the earnestness of their language, and to the sincerity of their affection for the pupils, were the first professors indebted for the success and durability of their work.

With the very limited capital above stated the Central School has not only educated a considerable number of able engineers who have rendered distinguished services to industry, and have taken rank among the first constructors of railways, or have introduced improved metallurgical processes, &c., but it has also made to M. Lavallée a profitable return for his capital. Had M. Lavallée retained possession of the school he would probably have gained twice as much, but in accord with a majority of the council he decided, with the most praiseworthy disinterestedness, on transferring this fine establishment to the State. We formed part of the minority of the council opposed to the project of transferring the school to the Government, basing our resistance chiefly on the ground that administrative forms and routine would oppose obstacles to improvement in our teaching. There can be no doubt that administrative formalities, notwithstanding the good feeling of the Government towards the Central School, may in some cases impede its development.

However, we feel bound to confess that experience has removed all our apprehensions, and convinced us that large establishments like the Central School cannot, without inconvenience, be left in the hands of speculators, as there would always be reason to fear that the excellence of the teaching might be sacrificed to the desire of realizing the greatest possible profits in the shortest possible time. Can anyone believe, for instance, that the Polytechnic School and the Schools of Law and Medicine would have been well placed in the hands of speculators? We may be allowed to doubt the fact. Now the Central School is nowise inferior to those institutions; it is the great school of industry.*

AUG. PERDONNET.

PROGRAMME OF THE CENTRAL SCHOOL FOR THE YEAR 1867.

First Year.—Analysis and general mechanics, 60 lessons. General physics, 60 lessons. Inorganic and organic chemistry,

* In England the home *par excellence* of private enterprise, the University of London, and the School of Mines, have become necessarily public establishments.

60 lessons. Theoretical and applied kinematics, 24 lessons. Construction of machines, 20 lessons. Hygienics and applied natural history, 20 lessons. Mineralogy and geology, 30 lessons. Architecture, 10 lessons. Industrial drawing, 20 lessons.

Second Year.—Applied mechanics, 60 lessons. Strength of materials employed in machines and constructions, 24 lessons. Construction and mounting of machines, 60 lessons. Analytical and industrial chemistry, 40 lessons. Metallurgy, 20 lessons. Civil constructions, 60 lessons. Industrial physics, 45 lessons. Industrial and commercial legislation. Ceramics, 8 lessons. Dyeing, 12 lessons. Glassmaking. Mining, 20 lessons.

Third Year.—Applied mechanics, 60 lessons. Construction and erection of machines, 55 lessons. Analytical chemistry, 20 lessons. Industrial and agricultural chemistry. General metallurgy and metallurgy of iron, 60 lessons. Mining, 20 lessons. Public works, 60 lessons. Steam engines, 35 lessons. Railways, 40 lessons. Naval constructions, 25 lessons.

In addition the following practical exercises and studies are required :—

First Year.—Various chemical manipulations. Exercises in general physics, stereotomy, and taking of plans. Architectural and topographical designs, and working drawings. Problems in the infinitesimal calculus, general mechanics, and general physics.

In the course of the year the pupils all undergo 27 examinations on the different branches of study, and a general one at the end of the year. During the vacation after the first year's studies the pupils are expected to make plans of buildings and machines; also to write an essay on the resistance of materials.

Second Year.—A practical study of the flow of gases with the aid of an anemometer and a ventilator; each pupil to draw up a paper on the subject. Construction with bricks, according to given plans, of various chimneys, a baker's oven, a lime kiln, a hot-air stove, &c. Each pupil to make a survey and draw a plan of a watercourse, and to measure the volume of water in a stream; a paper to be sent in upon the details of these operations. Practical exercises in a factory on the construction of machines. Twenty-seven manipulations in analyzing and assaying. Drawings and projects of machines and buildings. Each pupil passes 21 examinations on the different subjects studied, besides the general examinations at the end of the year. During the vacation after the second year, the pupils are to visit manufactories, &c., and to hand to the director on resuming their studies, a diary giving a summary account of the studies made and the factories visited; an album containing notes and sketches made on the spot; fair drawings of the most remarkable objects contained in the album; and a paper on questions of applied mechanics.

Third Year.—Projects, in two series; the first in the more important subjects of all the courses, and comprising four different studies, required from all the pupils of the division. The second belongs exclusively to specialties and consists of four projects on

subjects connected with machines, buildings, metallurgy, and chemistry.

All pupils of the third year who have satisfied the requirements of their division are admitted to this competitive project. The work consists of a complete study of the questions connected with a given project belonging to their specialty; it comprises numerous drawings with written explanations.

The pupils of the third year undergo 20 examinations during its course, besides the general ones at its close.

ACCOUNT OF THE IMPERIAL SCHOOLS OF ARTS AND TRADES.

Historical Summary.

In the year XI. there were three Government colleges, which formed what was called the *French prytaneum*. These colleges were situated at Paris (Louis-le-Grand), Saint-Cyr, and at Compiègne. In these establishments, which were under military discipline, the pupils were taught French, the classical languages, ancient history, geography, drawing of the figure, and mathematics. Most of them were educated at the public expense.

One day, the Emperor, while still First Consul, paid a visit to the college at Compiègne and questioned some of the elder pupils as to what they intended to do on leaving the college. He was much dissatisfied with their answers. "The Government," said he, "pays considerable sums to educate these young men, and when their studies are ended none of them, except those who enter the army, are of any use to the country. Nearly all of them remain at home, a burden to their families, which they ought to aid. This shall continue no longer. I have just visited the great manufacturing establishments in the north and the larger workshops of Paris. I everywhere found foremen clever in the manual labour of their trades, but scarcely one among them able to draw the outlines or make the most simple calculations of a machine to convey his ideas by a sketch or a written description. This is a great defect, and I will here provide the means for remedying it. There must be no more Latin here, that will be learned in the lyceums about to be organized; but the study of trades, with so much theory as is necessary for their progress; by this course we shall obtain well-taught foremen for our manufactories."

This was the real starting point and the object of the Schools of Arts and Trades. A few days later the *Moniteur* published the following decision of the 6th Ventose, year XI. (25th February 1803),* "From and after the month of Germinal year XI. the

* A few months later the Paris section (Louis-le-Grand) was transformed into a lyceum on the creation of these new colleges, and by a decree of the 15th Vendémiaire year XII., the college of Saint-Cyr was alone to bear the name of *French prytaneum*. It was afterwards removed to La Flèche.

teaching in the College of Compiègne shall have for its object the training of workmen and managers of workshops."

The pupils under 12 years of age were divided into three classes, in which they received an elementary education:—1. Reading, writing, and the rudiments of French grammar. 2. Continuation of the same studies, with the four rules of arithmetic. 3. The same studies, with the elements of geometry and first principles of drawing. From this college the pupils passed to the School of Arts and Trades, where, according to the occupations which they were to pursue, and qualifications, they were distributed among the different workshops, as,—1. Smiths, filers, fitters, turners in metal. 2. Founders. 3. Carpenters, joiners for buildings, furniture, and machines. 4. Turners in wood. 5. Wheelwrights. In these shops they worked eight hours a day. There were six classes, according to the proficiency and aptitude of the pupils. Only two hours per day were devoted to the study and to theory, including geometry, descriptive geometry applied to the arts, drawing and tinting of plans and machines. It was also arranged that those who should make great progress and display extraordinary talents should receive a more advanced education. They were to continue the same studies, and were also to be instructed in the application of the principles of mechanics to the practice of the industrial arts.

Such, as regards both theory and practice, was the system of instruction at the College of Compiègne, which, at the close of the same year, assumed the name of *School of Arts and Trades.* Pupils were admitted at any age,* and at all times of the year. The number was fixed at 500. The Emperor, when hunting in the Forest of Compiègne, was very fond of visiting the school, and entering into familiar conversation with the pupils.

By an imperial decree of 5th September 1806 the School of Arts and Trades was removed to Châlons-sur-Marne.

That same year the Duke de la Rochefoucauld,† who had been repeatedly requested by the Minister of the Interior to visit and

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* During the year several notices were inserted in the *Moniteur*, granting scholarships in the College of Compiègne to the children of parents who had died in the army or other branches of the public service. There was a class or category of very young children, whose management was confided to a lady-governess. In virtue of a decree of the 16th Frimaire (7th December 1805), which adopted the children of the generals, officers, and soldiers who fell at the battle of Austerlitz, even children at the breast, with their nurses, were sent to Compiègne.

† The Duke de la Rochefoucauld had founded at his farm of La Montagne, near Liancourt, a small school for the children of his regiment of dragoons, whom he could not, owing to the regulations, get admitted as "children of the regiment." This school was afterwards enlarged to receive children from regiments whose colonels were friends of the Duke.

Two non-commissioned officers taught the children reading, writing, and arithmetic. Those who wished were also taught trades that might be useful in the regiments, such as tailoring and shoemaking. This school contained nearly 80 pupils (in 1791) when the Revolution came. The Duke was soon afterwards obliged to leave his country, and his property was confiscated. The Government of the day then established, in the Duke's country seat at Liancourt, a new military school, of which his little school was, as it were, the

inspect the School of Compiègne, accepted the duty of inspecting the school transferred to Châlons, and presided at the distribution of prizes there. "He reminded the pupils," says the official journal, "that the idea of the establishment was entirely due to the genius of His Majesty; that the Emperor, in adopting them as his children, had rewarded in their persons the services rendered by their fathers; he enumerated all the advantages of the institution; he expatiated on the abundant sources of knowledge offered them by the school—geometry, physics, chemistry, and, above all, mechanics, that daughter of the other sciences, which would some day assure them a social position and open to them an honourable and useful career."

I will not here mention in detail all the classes and workshops for which prizes were then distributed, it will suffice to say what they were in 1812, after many modifications, and what prizes were awarded in that year by the Inspector-General:—

	Prizes.		Prizes.
Forging - - -	2	Compass makers - -	1
Fitting - - -	2	Cabinet work† - -	2
Mathematical instruments.*	2	Wood-turning - -	1
		Lock-making - -	1

nucleus. The schools of Popincourt, St. Martin, &c., were removed to the same place. The establishment thus formed was at first much neglected, but was afterwards better cared for and enlarged. When the School of Mars was suppressed on the 25th July 1794, those of its pupils who chose were sent hither, and their costume was subsequently adopted for the whole school.

On the 8th Germinal year IV. (29th March 179€), being the *Fête de la Jeunesse*, there was a distribution of prizes at the National School of Liancourt, and the director, M. Crouzet, then stated that the pupils were divided into the following classes:—

1. Mathematics.
2. Drawing and fortification.
3. French grammar.
4. Writing.
5. Music.
6. Reading (*1st division*).
7. „ (2nd „).
8. Tactics or military exercises.
9. Trades.

The Duke de la Rochefoucauld, having been allowed to return to France some days after the 18th Brumaire was almost immediately, in honour of his philanthrophy and noble qualities, restored to the possession of his Liancourt estate, which had not been sold owing to the presence of the school. This last was then removed to Compiègne, about eight leagues distant. At the request of the Minister of the Interior the Duke consented to pay a visit of inspection to the school at Compiègne, and continued his visits till it was removed to Châlons. Notwithstanding the distance he still performed the same functions, and was appointed Inspector-General, but without a salary, accepting only his travelling expenses. He held this office till his dismissal in 1821, taking great interest in the prosperity of the schools, and also exerting himself to find situations for the boys when their education was finished.

The Duke de la Rochefoucauld was not the founder of the Schools of Arts and Trades, but he was at least their benefactor and protector, and he may almost be regarded as one of the founders, as his little school at the farm of *La Montagne* led to the establishment of that at Liancourt.

* Including philosophical instruments.

† The school made furniture for the Crown until 1841 or 1842. This workshop also executed a good part of the furniture for which a gold medal was awarded in the Exhibition of 1824. On that occasion Louis XVIII. highly commended a flower-stand, with gilt bronze ornaments, which were also cast at the school.

	Prize		Prizes.
Wheelwrights' work* -	2	Founding‡ - -	- 1
Clock-making† - -	1	Chasing§ - -	- 1
Joiners' work - -	2	File-making -	- 1

There was also at Châlons, until 1814 or 1815, a small spinning-mill, worked by a water-wheel. When this was suppressed the director of the workshops took the machinery on his own account, put it upon the school premises, and worked it by horse-power, 10 or 12 of the pupils successively minding the spinning, but it was not kept up long.

The course of instruction was arranged as follows :—

Mathematics.	1st Section.—1. Descriptive geometry - -	1 prize.
	2. Statics, three series or classes -	3 prizes.
„	2nd Section.—Elementary mathematics, three series or classes - -	3 „
Grammar.	1st Division - - - - - -	2 prizes.
	2nd Division - - - - - -	1 prize.
Drawing.	Of the figure -	2 prizes and 1 grand prize for drawing from the round.
	Elements - -	2 prizes.
	Tinting . - -	2 prizes, and 1 grand prize for drawing machines.

This system of work in the workshops and the school, which was afterwards justly criticised, attained the proposed end of enabling the youth adopted by the State to earn a livelihood. It fitted them to become foremen and overseers in the trades they had learned at school : and the higher theoretical instruction given to the more talented pupils allowed them to promote the progress of the manufactures to which they devoted their attention.

But it will perhaps be asked how could it lead to progress in the arts of the cabinet-maker, the wheelwright, the chaser, and the locksmith, or, indeed, of the filemaker ? One must remember the state of industry at that time and the ignorance of artisans in general, and it will be seen that drawing might be of some use even to the four trades just mentioned. Even the apprenticeship to file-cutting was not then so very ridiculous, as in the very same year 1812, we find the Sub-Prefect of Beaupréau, at the first distribution of prizes to the pupils of the school there, complimenting them on having supplied the country with new and improved tools, and *especially with better files for the use of locksmiths.*

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* A considerable number of baggage and ammunition waggons were made for the army in the late wars of the Empire.

† Town and church clocks, which were much esteemed.

‡ For ordinary iron castings and bronze ornaments.

§ Modelling of the figure and of ornaments (continued till 1841), chasing and gilding. Until 1843 there was a master for modelling, and many pupils attended his lessons voluntarily.

Having thus mentioned the school of Beaupréau I may here add, that it was founded pursuant to a decree of 1st November 1811. At first the pupils did not exceed 150. The Emperor was undoubtedly influenced in the choice of this locality by the vicinity of La Vendée, which he was anxious to see advancing in the path of progress, and thus become attached to his Government, as also by the near neighbourhood of Chollet, and of manufactories to which the school might be useful. M. Molard, the director, several professors, and a number of pupils, were sent down from Châlons to form the first nucleus of the school. The results obtained during the first year were such that the sub-prefect, as I have already stated, highly complimented both teachers and pupils. In his speech we find the following passage: "With such an organization your rising school advances rapidly towards its object; our manufacturers there find useful recruits; our workmen of every kind new and improved tools; our locksmiths especially are supplied with better files; the towns with fire-engines, &c. In mathematics your efforts are satisfactory, and in drawing the examinations and the public exhibitions have brought to light promising talents."

This school, which had also its workshops, was still improving its organization when, on Napoleon's return from Elba, the insurrection in La Vendée compelled its removal to Angers, where it has remained ever since. It was also proposed that a third school should be established at St. Maximin, but the project was never realized. In the imperial period, notwithstanding that so many of the pupils entered the army, the schools rendered good service to industry. The grateful ex-pupil Xavier Jourdain, the benefactor of the Châlons school, is a living proof of this fact. The pupils of the school of Châlons also played their parts as patriots in defending France against the foreigner in 1814 and 1815. They served as gunners, and fought at the very gates of the town.

The Restoration still maintained the Schools of Arts and Trades. A royal decree of the 26th April 1817, orders the continuation of the schools of Châlons and Angers "both on account of the object they have in view, that of training overseers and workmen skilled in the practice of the industrial arts, and for their organization. The workshops of different kinds are to be kept in active operation. Drawing, and the elements of theoretical knowledge applicable to the arts are still to be taught there. The number of pupils kept, wholly or in part, at the expense of the State is fixed at 500, of whom three-fifths are entirely gratuitous, one-fifth pay a quarter of the school charge, and the other fifth one-half." No change was made in the practical or theoretical studies. The rest of the decree relates to the organization and to the staff, with very few details.

But industry required to be developed, especially the branches dependant on machinery, which, amongst us, was still in its infancy. Only remember the state of the manufactures in 1825 and 1826. It was indispensable to do something to help them,

and the great desideratum was educated workmen. The object of our schools was no longer to rear from their very cradles the children left fatherless by the works of the Empire; their present business was to communicate to the greatest possible number of intelligent youths the benefits of an industrial education.

A royal decree of the 31st December 1826 completely changed the organization of the schools, bringing them up to the level of present progress, and giving them facilities for adopting further improvements.

The following is a brief abstract of the more important regulations:—"The course of instruction shall henceforth be limited to four years. Pupils are to be admitted only once a year, and after examination."

The conditions are not very hard; but what was the state of primary education in the provinces at that time and for years afterwards? Candidates were only required: "To be able to read and to write correctly, and to know the four first rules of arithmetic." This was not much certainly, but still the principle of competition was introduced.

"Candidates must be thirteen years of age, and not above seventeen. Every department retains its right to send three exhibitioners; one without any charge, the second to pay one-fourth of the charges, and the third one-half. The Society of Encouragement also retains its privileges in this respect. The number of pupils is limited to 600, of whom 400 are to be at Châlons, and 200 at Angers. Two-thirds of every day are to be devoted to practice, and and one-third to theory. The trades taught are those of the wheelwright, carpenter, and joiner; blacksmith, filer, fitter, turner in wood, turner in metals; moulder, iron-founder, brass-founder."

"The theoretical studies are, in the first year: writing, French, grammar, and arithmetic. The following years: geometry and trigonometry; descriptive geometry with its various applications; the elements of physics and chemistry applied to industry, and the mode of ascertaining the strength and resistance of building materials. Those pupils whom the board considered worthy were allowed a fifth year of study.* Ten pupils of the last class might be placed out as apprentices at the expense of the State in large manufactories to complete their instruction. Figure drawing is suppressed, but the drawing of machines and ornaments as well as tinting is continued."

The above extracts show that the change was complete, but nothing less would have sufficed to realize the object of the Schools of Arts and Trades, owing to the rapid progress of industry at that

* This supplementary year, revived in 1848, as well as the apprenticeship at the public expense, has not been very successful. The pupils have derived but *little* advantage from it. Those who, at rare intervals, still apply for it, seldom complete their year, notwithstanding the advantage of instruction in one or more workshops. As a general rule those pupils do best who follow the ordinary course and work for their living as soon as their apprenticeship is completed.

time and in the years following. Nevertheless, in 1832, notwithstanding the services rendered the schools were attacked as being behind the time.

After the revolution of 1830, they had been again put *under* military discipline, subjected to drill, &c., and the Châlons school especially, of which a retired officer, General Saint-Remy, was appointed director. Owing to this change the impulse given by the royal decree of 1827 almost ceased to have any effect, *but* the schools being zealously defended, especially by M. Charles Dupin, were kept up with certain modifications which adapted them more completely to their purpose, and were destined to render them eminently useful.

Indeed, what ought the Schools of Art and Trades to have been at that period?—A kind of polytechnic schools for mechanical industry, which can make but little progress without *theoretical* knowledge.

The pupils were therefore compelled to study the sciences, and also to practise those manual operations which were to give them a kind of general preparation for the occupations of the various workshops among which they would be dispersed after the close of their studies. It was found necessary to neglect *those* industries in which the theory taught in our schools could find no useful application, such as the craft of the wheelwright, carpenter, and joiner, which can easily be learned by an ordinary *apprenticeship*; the workshops of the school might thus be reduced to four all of which are directly connected with the construction of machinery.

This change was effected by a royal decree of the 23rd September 1832, which established the school very nearly on the same footing as at present. There was no alteration made as to the number of pupils (600), in the school charges (*1,500fr. a year*), in the age of admission (14 to 17), or in the exhi*bitions*.

The labour in the workshops was confined to founding in iron and brass; turning in wood, and pattern making for castings and parts of machines; forging in the rough, and fitting and putting together of machines. A board of examination for admission is named in each department of France, and the examinations take place simultaneously in August. The programme of admission received one addition, which is, that the candidate must have served a year's apprenticeship to one of the trades taught at the school. The departmental scholarships were granted by order of merit on the list of each Department. The board places those candidates first whose acquirements are not limited merely to reading, writing, and the first four rules of arithmetic. Seventy-five certificates entitling the holder to a reduction of one-fourth of school charges were to be divided among the department, as an encouragement to the pupils, according to the place they obtain on the list of the school (two-thirds for Châlons and one-third for Angers). The workshop prizes, founded in 1825 by a legacy producing 3,000 frs. a year, bequeathed by Mme. Leprince, were confirmed. The length of the studies was reduced to three years, while the theoretical studies remained nearly as they were. Exa-

minations for classing the pupils according to their proficiency must be held twice a year in each school, and prizes are given at the close of the year: those for pupils about to leave the school are silver medals. Pecuniary encouragements were also awarded to such pupils as the minister might think deserving, but they were not to be given till the next year, and on the production of certificates, showing that the holder is following his trade and stating the position he occupies. The prizes of the Government were not given to pupils for their progress in any special branch, but for general proficiency in all the subjects taught at the school. A standard number of marks for each subject according to its importance was established. Manual labour was to be taken into account as well as the theoretical studies and drawing.

But to permit of this extension of practical instruction, suitable workshops were necessary. They were accordingly undertaken at the expense of the schools, first at Châlons in 1838, by M. Vincent, the director, who gave the first impulse (at the risk of leaving his successor some little financial embarrassment). They were commenced somewhat later at Angers (when M. Dauban was director), and the number of pupils there was then increased to 300. Subsequently the Government intervened, and the works were pushed on rapidly, and on a scale sufficiently extensive to meet all requirements, at least for the time.

In 1841 the two schools were placed on a footing of perfect equality as to the number of pupils which was fixed at 300 for each. But as this number soon became insufficient, it was considered desirable to found a third school. As the first two schools were in the north and centre of France, the Government decided on having the third in the south. It was first thought of choosing Toulouse for its site, to which town it had been proposed, in 1823, to remove the Châlons school, but the preference was ultimately given to Aix in Provence, within easy distance of Marseilles and Toulon. This third school was established on the same footing as the other two, with 300 pupils, and the same studies both theoretical and practical.

After February 1848 the schools were nominally submitted to military discipline; the first division was exercised in musket drill, but only during play hours. In October, however, the arms were withdrawn, and the usual studies were continued with great ardour, as before. During this same year the inspection was confided to General (then Colonel) Morin, who introduced some very beneficial modifications in the courses and the drawing lessons.

In the programme of the mathematical courses, the most important addition was that to the course of industrial mechanics, which, taking advantage of the improvements effected by General Morin himself in that science as first taught by General Poncelet in lectures to the workmen of Metz, became more practically useful and embraced a wider field. The course was terminated by dynamometrical experiments, made in the presence of the pupils, with regard to traction and the work of machines. The use of the sliding rule was introduced in the three divisions. Drawing of details of machines were made from models obtained from the

workshops of the best mechanical engineers in Paris, all in linear drawing, as in actual practice. The tinted drawings of the third year were made on improved systems. The making of projects of factories and of important machines was abandoned and replaced by drawings of machines with detailed calculations of the principal parts. To teach plan drawing, practical progressive exercises were performed every year by the pupils.

The decree of the 19th December 1848 sanctioned the existence of the schools, their mode of instruction and their organization, as well as the various exhibitions given by the Government. It also regulated the conditions of admission and the boards charged with the examinations in each department. It further confirmed the minimum of age, which for some years past had been fixed at 15, experience having proved that boys of 14 were not sufficiently developed to bear the bodily and mental fatigue of *going through* the whole course of instruction in three years. The qualifications for admission, which, considering the minimum of age (now raised to 15), and the progress of primary instruction were by no means a proof of capacity (reading, writing, and the first four rules of arithmetic) were altered so as to become a real test of the capacity of candidates. These qualifications were henceforth to be: reading, writing, orthography, practice and demonstration of the first four rules of arithmetic, fractions, and the decimal system; geometry, so far as regards plane surfaces.

In addition also to the oral examination, there were introduced: problems in arithmetic and geometry from dictation; linear drawing or drawing of ornaments; and an exercise in the manual labour of the trade to be learned, performed in the presence of a practical man. As already stated, the duration of the studies was fixed at three years, but a fourth year for improvement was allowed, as a recompense to ten pupils in each school, chosen *from those* who had obtained a workshop prize, or one of the 15 medals. (I have previously stated in a note that this fourth year led to no good results.) The rewards in medals and money prizes were maintained as well as the workshop prize founded by Mme. Leprince for Châlons and Angers. The 17th article regulated the teaching staff, with the salaries and progressive increase at intervals of five and ten years.

Such is the rather long chronicle of the Schools of Arts and Trades from their origin to the present day. It may be thus briefly resumed.

The schools founded to train educated workmen and overseers in the industrial arts, and also, at first, to bring up the orphans of soldiers in a trade by which they might get a living, have been successively modified so as to keep pace with the progress and development which time has wrought in industry. They have advanced in theory and practice as occasion requires, and have at last come to be more especially applied to general mechanical industry, for which theoretical knowledge is indispensable.

I will not conclude this sketch of the schools without remarking that they have received marks of interest from all the sovereigns who have ruled over France since Napoleon I., and also from the

princes and princesses of their families. The school of Châlons was visited by the Duke of Angoulême in 1817 or 1818, then by Charles X. on his coronation at Rheims, and on the same occasion by the Duchess of Angoulême and the Duchess of Berri. In after years, King Louis-Philippe, accompanied by two of his sons, also visited it, but incognito, and subsequently the Duchess of Orleans, on her arriving in France. The ministers Cunin-Gridaine, in 1842, and M. Dumas, the illustrious chemist, in 1850, likewise paid a visit to the school, and testified the interest they took in such institutions. The school at Angers was also visited by the Duke of Angoulême in 1824, and by the Duke and Duchess of Nemours in 1843.

The Present Organization of the Schools of Arts and Trades (1864).

We now proceed to give an account of the studies, theoretical and practical, of the time devoted to them, and of the methods of teaching. This will oblige us to enter into rather long details.

The pupils are admitted after examination, and once a year only, on the 1st of October. The instruction extends over three years. Sunday is the only day of rest; there is no holiday or half-holiday on Thursday. There is no time lost; and the pupils are accustomed to the life of the workshop, by being fully occupied six days per week from the time of entering the school. Five hours and a half are devoted to theoretical study and seven hours to practical work; in all twelve hours and a half.

The theoretical study is divided into two parts, four hours and a quarter in the morning and one hour and a quarter in the evening. The early part of the day, when the head and ideas are fresh, is chosen for the mathematical lectures and interrogations, and also for drawing. There is little study properly so called in this portion of the day. The evening sitting is more especially employed in study. The grammar and writing classes are interposed between the two sittings, so as to make the best use of the time. The practice in the workshop is divided into two equal portions (from ten to half-past two and from half-past three to seven), separated by the dinner and the playtime after it. This interruption of the manual labour rests the body, as the work itself rests the mind for the evening studies. The pupils rise at a quarter past five and make their own beds.

The whole school is divided into three classes (or years of study), each having its own professor of mathematics or mechanics and of drawing. There is also a professor of grammar for the three divisions, and a professor of writing for the first two years only. The chaplain, in addition to the performance of divine service, gives a lecture every week in religious and moral instruction.

I have heard persons dispute the utility of the grammar and writing lessons for our pupils, who ought to know those branches when admitted. But does not the orthography of school boys require to be kept up by practice, and are they all adepts in

spelling? As for writing, they acquire a better hand at school, and in the last half of the second year they have to practice industrial book-keeping. The progress made in these two branches prove their utility.

In mathematics, we have not, properly speaking, any methods peculiar to the school. In their lessons the professors go straight to the object in view without noticing any of the subtilities of the science. But numerous applications exercise the pupils' minds and fix the principles in the memory by showing their utility. In the interrogations the boys are stimulated to answer promptly.

Bobillier's geometry, composed expressly for our school, is essentially simple and precise; for descriptive geometry we follow Theodore Olivier's method and notation; for mechanics the spirit and method of the course of MM. Morin and Tresca, abridged.

In the first year the professor goes rapidly through the programme of admission, thus systematizing the different methods learned elsewhere before proceeding with the same subjects. He follows his pupils through the two years of mathematics proper, during which he teaches them: arithmetic, algebra, as far as and including quadratic equations, elementary geometry, comprising curves of the second degree demonstrated geometrically, plane trigonometry, the elements of descriptive geometry and cinematics or geometrical mechanics.

In the third year a professor teaches industrial mechanics, including hydraulic machines and steam-engines; of physics, the principal general elements, and in considerable detail; lastly, a few elements of chemistry, the nomenclature, and what bears more especially on materials. Numerous practical applications varied for each pupil exercise the pupils in mechanics. The repetitions or interrogations are made by the professors and by foremen of the workshop.

Drawing is taught very simply. In the first year the pupils to get the free use of their hand, make designs with the drawing pen comprising all the principles of symmetry of joining curves, &c., which they will require later when they come to draw machines. Most of these exercises are taken from architecture, of which the pupils also learn some of the elements. For this part only, the drawings are copied from models. Geometrical drawings, designs of joints in carpentry and joinery, elementary exercises in drawings tinted with Indian ink and dull colours, as well as two drawings of plans complete the first year's studies.

In the second year first the elements of machine drawing; next come, in the hours of study, working drawings of descriptive geometry, which require the most rigorous accuracy. On reaching this point the pupils having acquired neatness, clearness, accuracy, and precision, should be able to draw well. They immediately apply these principles to the geometrical drawing of machines, of gearing, &c. In this second year, the pupils in the workshops, in their drawing lessons, make sketches of tools and various machines to scale with dimensions given. In the third year they make drawings of machines and those relative to the lectures on mechanics. They also calculate the principal parts of the machines

they represent. They conclude with making drawings of machines in plain tints.

I have been thus particular respecting the drawing in order to show that this graduated method is at once simple and natural. The complete course of drawing in the three years comprises from 100 to 110 designs or working drawings. The professors of drawing also teach by a few progressive lessons every year, the principles of topography. These same professors execute, in the office of the engineer of the works, the projects and details of machines to be constructed in the workshops. Convalescent pupils, after hurts or illness, take part in these designs during the workshop hours.

Practical Instruction.

One third of the pupils are distributed in the preparatory workshops, that is, from 25 to 35 pupils in each of the three: the pattern shop, the foundry, and the smithy. The remaining two-thirds, amounting to about 200, work in the fitting shop.

The Pattern Shop.—The pupils begin with making simple patterns with boards, then each learns to execute all the different joints used by carpenters and joiners; next come patterns for founders (proceeding to the most complicated and most difficult), gearing (straight or bevilled, with or without mortising), cylinders, and framework for steam engines, &c. The pupils also make, but only as exercises in the handling and cutting of wood, and according to the demands of the country, articles of furniture, woodwork for churches, pulpits, &c., more or less ornamented.

The Smithy.—They begin with welding scraps of old iron into masses, and making tongs and other tools used in forging; they next forge small articles for exercise in filing and fitting, and then parts of machines, from the simplest to the most complicated. In the third year the pupils learn to use the steam hammer.

The Foundry.—They begin with plain castings of balustrades, palissades, medallions, and the simpler parts of machines; and then, as an exercise, in detached ornaments, before executing them on a large scale, the pupils make small busts, statuettes, &c. As a general rule, in this workshop, as in the fitting room, and at the forge, they begin with practice entailing but little expense of material. By degrees they come to the framework of machines, and the casting of large wheels, either with cogs or with mortise holes to receive wooden cogs; and, lastly, to the casting of steam cylinders, &c., according to the orders to be executed. More carefully executed statuettes of a larger size, Joan of Arc, La Tour d'Auvergne, the Magdalen, &c., give them some idea of artistic moulding which the school of foundry does not indeed profess to undertake, though such castings have occasionally been made there.* Most of the statuettes are executed in ordinary

* The school of Angers cast, on the 10th August 1861, the bronze statue of the Duke de la Rochefoucauld, which has been erected in the public square at

cast iron, and therefore cannot be ornamented with the chisel. All the operations of the workshop are performed by the pupils themselves, as making the moulds, charging the furnace, working the cranes, casting, paring and trimming.

The Fitting Shop.—The pupils begin with simple pieces of regular forms, requiring great attention to symmetry and precision, and for that reason very instructive. For instance, they first make two small iron straightedges perfectly true in every sense, then two squares accurate in every respect; next, with a piece of wrought iron, they make a regular quadrangular prism, and from it an octagonal prism; or a right cylinder, to be afterwards turned into a hexagonal prism, &c. After this they make various kinds of compasses, hand and claw vices, keys for screws, ratchets, &c., then bow-lathes, bench vices, pulleys, and lastly, all the different parts of machines, according to orders on hand, machine tools, steam engines, &c.

The general principles are:—1. To make, as a general rule, only one piece of the same kind, in order to know how to execute the greatest possible number. 2. To do all work, as far as practicable, by hand, and with the simplest tools.

The object is not to get as much money as possible by making the same thing over and over again, but to learn how to work well at all kinds of things, so that the pupil may be able to turn his hand to any branch of his trade where he may find an opening, and to fit him for entering any workshop, large or small, with a good store of practical knowledge. After one year's work, at most, in any specialty, a clever pupil will acquire all the rapidity of execution common to good workmen.

The machine tools, planing, mortising, and filing machines, are seldom used by the pupils till they can work well with the hand; but the less skilful always have the advantage of seeing these machines in use, and having been obliged to make drawings of them must be well acquainted with their principles. Each pupil has a vice to himself, and at each bench there are pupils of all the three divisions, that the more advanced may teach the juniors. There are also in each shop one or two workmen as examples for the boys, and they are also employed when required to put up the machines made at the school for private manufacturers.

The classing of the pupils according to merit, which, as already stated, takes place twice a year, is decided according to the entirety of the studies, theoretical and practical, and the same number of marks is allowed for the practical part as for all the theoretical studies. The classification made at the end of the year is followed by a distribution of prizes to the most deserving. These prizes, for the second and third divisions, consist of books on science or industrial art which may be useful to the pupil for his studies or after leaving the school. For the first

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Liancourt. This statue, 2 m. 80 c. (9 ft. 2 in.) in height, modelled by Mandron, the well-known sculptor (himself a pupil of the school of Angers), was cast in one piece with the most complete success, by M. Biesse, the manager of the foundry, and a pupil of the school.

division (the pupils who are about to leave) the prizes are silver medals, bearing the words: *School of Arts and Trades—Reward*, and the pupil's name engraved.

The maximum of medals is 15 for each school. A sum of money is sometimes added to give the pupil a start in life, but this is never paid till the following year, and then only on condition of the claimant's producing certificates that he has been working at his trade for the past 12 months. Each first workshop in the schools of Châlons and Angers receives, provided it attains the required standard of merit, the prize founded by Mme. Leprince, amounting to one-eighth of 3,000 fr. or 375 fr. for each.

At Châlons also, ever since 1863, there have been awarded three prizes of honour, founded by M. Xavier Jourdain, manufacturer, of Altkirch, as a testimonial of his gratitude for the education he received at the school, to which he attributes most of his success in life.* The first prize is a gold medal worth 300 frs. and a sum of 1,000 frs.; the second, a similar medal, and 500 frs.; and the third, a silver medal, with 400 frs. These prizes are awarded to three pupils chosen from among the first 15 on the list, regard being had to both study and moral conduct.

As my extracts from the decrees and regulations bore chiefly on the organization of the studies I will here add that each school has an annual grant with which it must meet all the expenditure, not only for the teaching staff and management, for the board and other outlay on account of the pupils, but also for materials and tools for the workshops, for the clothing of the pupils, and for the repairs of the buildings. The school has nothing beyond this grant. The receipts for the board of pupils, and for clothes, as well as the proceeds of the sale of things manufactured in the workshops belong to the State.

On the Utility of the Schools of Arts and Trades.

We have now to say a few words on the utility of these schools (though it is very generally admitted), and to answer the question, are they appreciated by the mass of the working classes?

They receive every year from 300 to 315 pupils (the average for the last four years is 312). The number declared admissible was 681 in 1863.

The number of candidates throughout France I am unable to state, but if we calculate on the data supplied by Paris, which had, for the present year, 125 candidates, of whom 48 were declared admissible and 25 were admitted, we should have for all France, taking the admissible for the basis, 1,700 candidates; taking the admitted as a basis 1,560 candidates, that is, between *five* and *six* times the number of admitted, or let us say *four* times. Admission to the Schools of Arts and Trades is therefore not only desired but most eagerly sought for.

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* M. Xavier Jourdain has also founded three scholarships at Châlons or boys of his native place.

But do the pupils, on leaving the schools, readily find situations, and at remunerative wages?—According to a return of the 465 pupils who left the schools in 1861 and 1862, after completing their studies, they occupied 12 *months afterwards*, the following positions :—

			Average Wages.	
			Per Day.	Per Year.
Various workmen, overseers, foremen, fitters, moulders, mounters, &c., in divers factories and workshops - -	110	188	3 fr. 75 c. to 4 fr. 35 c.	1,163 fr. to 1,350 fr.
Various workmen, overseers, foremen, moulders, fitters, &c., on railways - - -	78			
5 with their fathers, 6 in spinning mills - - - -		11		
Pattern designers for manufactories - -	88	165	3 fr. 90 c. to 4 fr. 65 c.	1,210 fr. to 1,441 fr.
Draughtsmen for railways - - -	77			
Engineers of the Imperial Navy or of the Messageries Impériales - - -		47		
Roads and bridges—road surveyors - - - -		22	—	1,000 fr. to 1,400 fr.
Army - - - - -		4		
Central school - - -		1		
Position unknown - -		22		
Dead - - - - -		3		
Not employed - - -		2		
Total - -		465		

This return shows that the pupils, from their very entrance on active life, are usefully employed for the general good, in factories, workshops, railway establishments, in the navy and navigation companies, in the bridges and roads. Two *only* were known to remain without employment. As to the earnings of the great majority 3 fr. 75 c. to 4 fr. 35 c. for mechanics, and 3 fr. 90 c. to 4 fr. 65 c. for designers, seems very fair wages for young men of 19 to 21 years of age. I know one, not comprised in the above, who was earning 6 fr. a day as a fitter, only 12 months after leaving the school.

But these young men only one year after leaving school, cannot, of course, have rendered any but unimportant services to industry. We will now proceed to show, by mentioning the honourable positions attained, after a longer lapse of time, how successful many of them have been. We find these data in the list of the society of ex-pupils of the Schools of Arts and Trades. It must be observed that here we are not speaking of pupils who have just left the schools, but of those who have been engaged in the active business of life for four, five, and even twenty years or more. Many of them are settled in Paris. There is

scarcely a single workman among them, the very small number who may still remain in the humbler position having neither time nor money to devote to this society.

		Decorated.
Heads of establishments working on their own account (construction of machines, apparatus of all kinds, and iron-works, founderies, &c.)	106	2
Spinning mill owners	4	1
Civil and mechanical engineers	71	6
Directors, heads, and professors in schools of arts and trades	9	3
Employed in various manufactures as chiefs of workshops, foremen, &c.	140	1
Railway officials and workmen	159	5
Designers for manufacturers	78	0
Chief and assistant engineers of bridges and roads	20	0
Master engineers and marine engineers	6	0
Various industries	21	0
Not in trade, six being in the army and four artists	30	4
Totals	644	22

Among the ex-pupils of all ranks there are 18 who have been decorated solely on account of their professional eminence.

List of the Officials of one of the Schools, with their Salaries &c. :—

Officials.	Salaries. On entering.	Salaries. After 5 years.	Salaries. After 10 years.	Observations.
	francs.	francs.	francs.	
1 Director	5,000	5,500	6,000	
1 Engineer of Works	3,000	3,500	4,000	
1 Treasurer	2,200	2,500	2,800	
1 House Steward	1,700	2,000	2,000	
1 Chaplain (Catholic)	2,000	2,000	2,000	Including 300 fr. for a lodging.
1 Professor of Mechanics	2,000	2,500	3,000	
2 „ of Mathematics.	2,000	2,300	2,500	
3 „ of Drawing	2,000	2,300	2,500	
1 „ of Grammar	1,400	1,800	2,000	If librarian, 400 fr. in addition.
1 „ of Writing	1,200	1,400	1,700	Professes industria book-keeping.
1 Overseer of fitting workshop.	2,000	2,500	3,000	
3 other Overseers	2,000	2,300	2,600	
5 Foremen fitters	1,700	1,900	2,000	The foremen, hearing repetitions receive an indemnity of 250 fr. In all (10 years) 2,250 fr.
3 Foremen for the three other workshops.	1,700	1,900	2,000	
1 Adjutant of 1st class	2,200	2,200	2,200	
If of 2nd class	1,300	1,300	1,300	With clothes and board.

Officials.	Salaries.			Observations.
	On entering.	After 5 years.	After 10 years.	
1 Director's Secretary, from 1,700 fr. to 2,000 fr. 1 Store-keeper, from 1,600 fr. to 2,000 fr. 2 Book-keepers, from 1,400 fr. to 1,700 fr. 8 Adjutants, one of whom is infirmary wardsman, from 700 fr. to 900 fr.	—	—	—	With clothes and board.

These salaries are evidently very low, even too low, and yet several, to attain the present sum, have been augmented by the successive increases of smaller salaries, thus :—

	frs.
The house-steward has an increase in his first two positions of - - - - -	200
The five professors of mathematics and drawing, in the first position only - - - -	200
The professor of grammar in the first two -	200
The professor of writing in the three -	200
The foremen of workshops in the three -	200

which brings these last, after 10 years, to the same amount as the overseers begin with, and gives them, with the extra for repetitions, 250 fr. more than the overseer, their superior, so that, if promoted to be overseers they lose 250 fr. a year *thereby*.

I mention this fact to show that a revision of salaries is necessary.

As to the number of hours devoted to their duties it may be thus stated :—Director, his whole time, and the engineer nearly the whole; treasurer, seven or eight hours per day; house-steward, nearly the whole day; professors of mechanics and of mathematics, during 10 months or 10½, six days per week, from two and a half to three hours of lessons and interrogations, without counting the revision of tasks and time for preparing their lectures at home; professors of grammar and of writing, about the same; professors of drawings from five to six hours in lessons, or in making drawings for the engineer or the workshops; overseers, eight or nine hours daily; foremen, eight or ten hours daily, including the repetitions; book-keepers, seven or eight hours a day (generally seven).

Le Brun,
Inspector of the Imperial Schools of Arts and Trades.

Paris, 20th March 1864.

NOTES ON THE POLYTECHNIC AND PHILOTECHNIC ASSOCIATIONS.

Public and Gratuitous Courses.

Origin and object of the Association.

The Polytechnic Association was founded in 1830 by ex-pupils of the Polytechnic School to the number of more than 500, and M. Victor de Tracy was chosen its first president. The object it had in view was to promote the progress of civilization, and its device was that of the old Polytechnic School: *Tout pour la patrie, les sciences et la gloire.*

Committees of public works and of education formed in the Association.

Two Committees were formed by its members, one of which, called the *Committee of Public Works*, greatly contributed to convince the public of the utility of railways, which was much disputed at that period; the other assumed the designation of *Committee of Education*, whose object was the diffusion of scientific knowledge among the working classes. The first-named committee has long ceased to exist, the second has become the present association. The Committee of Education, composed of MM. Victor de Tracy, Auguste Comte, Meissas, Thurninger, Goudinet, Guibert, Courtial, Perdonnet, founded in 1830, the still existing gratuitous courses for working men.

Temporary closing of the courses.

Some of the earliest professors, by mingling politics with their scientific teaching, endangered the existence of the rising institution. The courses were consequently suspended by the association itself, and the committee set to work diligently to reorganize its teaching on a new basis. Their efforts were powerfully aided by M. Guizot, who, from that time, honoured the association with his zealous and enlightened protection.

Expenses attending them.

The courses were given gratuitously, in rooms kept by the city authorities, at the Hôtel-de-Ville, the old Tribunal of Commerce, and elsewhere. Still, there were certain inevitable expenses for lighting, superintendence, models, &c. The cost of lighting was particularly heavy, because courses of this kind could be given only in the evening, when artisans have finished their day's work, or on Sundays.

Grants from the Minister of Public Instruction and the city.

The subscriptions of the members of the association, though only ten francs each, were at first sufficient to cover the outlay. But these payments soon fell off, and then M. Guizot came to our aid with extreme liberality; the municipality also contributed to the fund.

At present each of the two associations receives, to meet the outlay for lighting, warming, supervision, models, prizes, house rent, purchase of books:—

	Frs.
From the city of Paris - - -	5,200
From the Minister of Public Instruction -	1,500
Total - -	6,700

This sum is insufficient; we are obliged to add every year from 2,000 fr. to 4,000 fr., so that our association expends about 10,000 fr. a year for its lessons and lectures in Paris, for those

outside the city cost us nothing, all their expenses being paid by the local authorities or by private individuals. It will also appear very small when we reflect that the total number of the courses of the two associations in Paris is at least 150, and that of the whole total amount about 3,000 fr. go for prizes and advertising.

Courses established in nearly all quarters of Paris.

The Polytechnic Association has established courses in nearly every quarter of Paris, at the Hotel-de-Ville, in the Rue St. Méry, at the Halle-aux-Draps, in the Rue Ste-Croix-de-la Bretonnerie, in the Rue des Vinaigriers, in the Faubourg St. Antoine, in the Rue de Ponthieu, at the Mayory of the Petits Pères, in the Vieille-Estrapade, &c. But as the expenses exceeded the income, and as pupils were few in some places, it concentrated its efforts on two points—the Halle-aux-Draps and the Rue St. Méry. The courses were continued at the former place until the hall was nearly destroyed by fire in 1855.

Places where courses are now given.

At the present moment courses are given under the auspices of the Polytechnic Association, in Paris, at the Central School of Arts and Manufactures, the School of Medicine, the Communal School of the Batignolles; and, outside the walls, at Ivry, Vincennes, and Sceaux. In the provinces, courses for adults are given, under the patronage of the association, at Nemours, Ste-Marie-aux-Mines, Charleville, and Guebwiller.

Original professors.

All the courses of the Polytechnic Association, for the first three or four years of its existence were given by old pupils of the Polytechnic Schools; but the necessity of obtaining the aid of other professors soon became manifest. Nevertheless, the pupils of the Polytechnic had the sole management until the revolution of 1848. At that date, their colleagues, as they performed the same amount of work, also claimed an equal share in the management: the present president of the association *supported this* demand, but it was rejected by a majority.

Origin of the Philotechnic Association.

The consequence was that most of the professors who had not been educated at the Polytechnic School seceded in the year 1848 and founded a new association under the name of the *Philotechnic Association*, with the aid of the actual president of the Polytechnic Association. For some months M. Perdonnet remained president of the two associations, in the hope that a reconciliation might be brought about; but being disappointed in this respect, he resigned the chair of the Philotechnic, and was succeeded as president by his friend M. Boulay de la Meurthe. Since then the Philotechnic Association, successively presided over by M. Salmon, M. de Turgot, M. de La Riboissière, has been no less successful than its elder sister.

Number of professors and places of instruction.

The two associations together have, in Paris, no less than 150 professors. The Philotechnic Association gives its courses in Paris, at the Turgot School, the Sorbonne, and the School of Pharmacy; outside Paris, at St. Denis, Puteaux, Argenteuil, and Corbeil. Courses have also been established under its auspices at Nice. Its present president is the Count de La Riboissière, ex-pupil of the Polytechnic School; he is also the president of the Polytechnic Association.

One of the greatest difficulties experienced by the two associations in opening their courses of lectures was to find suitable premises; such places are scarce in the city of Paris. For want of better, we have to make shift with the Communal schoolrooms, but the benches and desks of those establishments being made for children are not convenient for adults. Sometimes we have been obliged to rent rooms. Difficulty of finding suitable premises.

We have never wanted professors. Competent candidates for gratuitous chairs are almost as numerous as for well-paid ones. Both the associations have abundant proofs of this important fact. Facility of obtaining good professors.

Since 1830, five or six crosses of the Legion of Honour have been given to professors of the Polytechnic Association at the instance of president. The palm-leaf of officer of academy and of public instruction has been presented in public sittings by the Minister of Public Instruction to several of the teachers. These rewards, given to professors only and bestowed appropriately, are a powerful stimulus.

The courses of the Polytechnic and Philotechnic Associations are of a higher order than the instruction given in the communal schools. The Polytechnic Association teaches neither reading nor writing. At the outset it selected as its models the courses given to the working classes at Metz by MM. Poncelet, Bardin, Bergery, &c. Nature of the instruction.

Taught by experience, however, it excluded from the list of subjects taught everything that could give rise to religious or political discussions, such for instance, as history, political economy, morals, &c. Not that the association considers such subjects of little importance, but because it sees the prudence of leaving them for others to teach. Exclusion of political and religious subjects.

Thus, the instruction given under the auspices of our association consists of courses of arithmetic (1st and 2nd year), geometry (1st and 2nd year), descriptive geometry, physics, chemistry, machines, drawing of the figure and of ornament, geometrical drawing, book-keeping, geography, natural history, elementary astronomy, grammar, hygienics, singing. The Philotechnic Association has also established, in addition, courses of English and German, which are not given by the Polytechnic Association. Nature of and admission to the courses.

It has been truly said that the Polytechnic Association is the working man's Sorbonne, as the Conservatory of Arts and Trades is the manufacturers' Sorbonne. Admission to all courses is not only gratuitous, but the pupils are also received without any conditions as to their previous education.

At the conclusion of each course, or even during its progress, the professors examine the pupils, and award prizes to the more deserving. The working men, however, do not very readily consent to be examined. Prizes.

A public meeting of the two associations united is held every year at the Cirque Napoléon, or the Cirque de l'Impératrice, and the Minister of Public Instruction always presides. The prizes consist of deposits in the savings bank, given by the Emperor, the Empress, the Prince Imperial, the Minister of Public Instruc-

tion, and of medals and books supplied by the association. They are reserved for artisans alone; shop-assistants and clerks, persons employed on railways, &c., are not allowed to compete.

The Philotechnic Association gives, in addition, certificates of study to those pupils who have obtained prizes in several courses. But the Polytechnic Association, considering that it has not the means of sufficiently ascertaining the merits of the pupils, does not think proper to give such certificates, of which the public might possibly overate the value. It occasionally grants exhibitions in the Central School to pupils who evince extraordinary talent; this is the highest reward it can give.

Duration of, and attendance at, the courses.

The courses begin in November and close in May. The number of persons who follow the courses is considerable in the first months, but there is a perceptible falling off in the beginning of January, and the attendance keeps declining as spring advances, till very few pupils are left at the close.

Some courses draw as many as 150 at the beginning, and end with 75 or 80; others never have more than 25 or 30 hearers. An account is regularly kept of the number of pupils attending each sitting, that the association may be able to judge of the success of its teaching.

A few years back, the pupils of the two associations were more numerous than at present. The reason is that, owing to an unfortunate rivalry between the associations or to other causes, too many courses of the same kind have been given in the same neighbourhood; perhaps, also, the opening of new schools by the City, and the migration of the artisan class to the suburbs, have contributed in some degree to this decline.

The audience is of quite a mixed character, there being a great many persons who are not artisans. Some courses, those of book-keeping for instance, are attended chiefly by clerks and shop-assistants. Our courses are also numerously attended by young candidates for situations as overseers and time-keepers in the Government Department of Bridges and Roads.

Children are strictly excluded from all the courses except those for drawing, in which the limit of age has been lowered to 15 years. The presence of young boys would keep away adults, for whom our instruction is specially intended.

Methods of teaching.

As to methods of teaching, the Polytechnic Association is eclectic; it admits all those which have acquired some reputation. Drawing, for instance, is taught by the old method, by the Dupuis or Tabareau method, and by a mixed method. Singing has been taught by M. Chevé as well as by M. Wilhem. Our intention was to try the application of the Tabareau method to different kinds of teaching, but we abandoned this design on the recommendation of M. Girardon, M. Tabareau's nephew, who assured us that the attempt made at Lyons to apply that mode of teaching to adults had succeeded for drawing only.

Defects of the teaching.

The teaching of the Polytechnic Association is far from being so near perfection as we could wish, as regards certain branches, especially descriptive geometry and machines. The difficulty is not to find teachers sufficiently instructed, but that those who

teach with success in lycées and boarding-schools, do not belong to the working class, have little knowledge of its wants, and are besides unable to give the precise kind of instruction required. It is possible, no doubt, to associate practical with theoretical professors, but where are we to find the former? There are indeed, clever workmen, who teach their comrades so much of the art of drawing as is necessary for their respective trades, but these workmen are accustomed to be well paid for their lessons, and would be little disposed to give gratuitous lectures. For teaching mechanism and mechanics we want models; we are at present, however, engaged in organizing with the aid of a manufacturer and of the chief engineer of the locomotive department on the Western Railway, a pupil of the Central School, a course of practical instruction in mechanics, which we hope will prove successful.

Decline of the drawing classes.

The drawing classes of the Polytechnic Association were very flourishing fifteen or twenty years back; they are now in a declining state. This may fairly be attributed to the opening of new schools by the city, to our inconvenient rooms, &c. We are making great efforts to remedy this state of things, and have already realized great improvements at the Central School.

Programmes of the courses.

There are in circulation excellent programmes of lectures given by the Philotechnic Association; those issued by Polytechnic Association have been some time out of print, but new ones are now in course of preparation. The manner of drawing up these programmes appears to us a matter of great importance.

Objections against courses for adults.

Courses for adults have been exposed to the following objections:—1. That the artisan, after a hard day's work, must be, as a general rule, little disposed for intellectual effort. 2. That being sometimes obliged to work over hours in the evening, he cannot be regular in his attendance.

The first objection is unfounded. Intellectual effort after bodily labour is a recreation rather than a fatigue. Energetic workmen, who know the value of instruction, find a pleasure in attending classes, if not every day, at least once or twice a week. There are abundant proofs of this; whoever looks over the list of prizemen will find that the greater part have been given to hard working artisans.

The second objection is, perhaps, more serious. However, we must remark, that in certain establishments over-hours are rare, and that if, in some few the men work late and miss lessons, they can easily learn what has passed in their absence from the notes of their comrades.

System of administration.

The Polytechnic Association is managed by a standing committee, the president of which is appointed for life; all the other members for three years only; but down to the present time all have been constantly re-elected. The direct management really belongs to the president, acting with the cordial co-operation of the professors.

In the Philotechnic Association the president and standing committee are elected for one year only, and the members of the

committee are frequently changed. This instability appears to us a matter of regret.

Results of the instructions.

On the whole the instruction given by the two associations has certainly produced good results. Thirty-three years ago, when the Polytechnic Association began its labours, the general character of the working class was certainly of a lower standard than at present. This improvement may fairly be attributed, if not wholly at least in part, to the action of our courses.

It would be difficult for us to say what becomes of all our pupils. However, we do know for certain that many of them are in good employ as mechanicians on railways, as workmen, foremen, and even as directors of manufacturing establishments. Among these last we may mention the manager of the workshops of the Messageries Impériales at Paris. Many begin their studies in our classes, acquire a taste for intellectual exercises, and complete them elsewhere. Of these we may instance the director of a large manufactory of aluminium in England, several bronze manufacturers at Paris, &c.

As already stated, there are some who, having evinced unusual talent, have, with our aid, entered the Central School. Among this number is a cabinet maker who entered the Central School when 30 years of age, and is now at the head of a large manufactory on the banks of the Rhine, with a salary of 15,000 fr.; another, who had been brought up as a brushmaker, is now an engineer and distinguished professor of mathematics; and a third, who was a land surveyor, is now an engineer.

It is a universal complaint with manufacturers that their workmen are not sufficiently educated. Courses like ours are intended to remedy this defect, just as the teaching of the Central School is meant to train engineers for the conducting of important enterprises.

While the instruction given by the Polytechnic Association has produced good fruit, it has also, we freely confess, done some mischief. For instance, two of its pupils, one a lithographer, the other a stone-cutter, after obtaining prizes of honour, requested us to procure them situations as overlookers on railways. This proves that, in certain cases, instruction given to adults, instead of leading them to improve their condition as workmen, turns their heads and makes them desirous of obtaining situations for which they are no way fitted.

But this is no reason for refusing to disseminate knowledge among adults of the working class. Our highest special schools sometimes produce similar results, but are nevertheless most serviceable. The essential point is to give the instruction the right direction, and make it in every way appropriate to the workman's wants. It is also indispensable to give good advice to those who may wish to abandon their proper career like the two prizemen above mentioned.

Conclusions.

From the results of our experience in the teaching of adults we conclude as follows:—

1. That at Paris this kind of instruction cannot be of long

duration unless the Government or the city find convenient premises for the purposes.

2. That without public assistance it would make but little progress, if not altogether cease. Very small grants are required, as all the professors give their lessons gratuitously.

3. That the interveution of the Government at the public distribution of the prizes greatly contributes to success.*

4. That it is easy to find a sufficient number of good professors, but sometimes difficult so get rid of incompetent ones.

5. That the present mode of teaching in certain branches, especially descriptive geometry, practical mechanics, &c., is not satisfactory, and that improvement is difficult, at least in Paris; in the provincial manufacturing districts there is less difficulty.

6. That the courses being very numerous, the supervision of the teaching given is no easy matter, but is nevertheless necessary in order to keep the institution within its proper bounds.

7. That the system of no payment on the part of the pupils adopted at the origin of the association is open to serious objections. The pupils would probably be more punctual in their attendance if they had to pay a certain sum monthly, however trifling; but, in that case, they must not be allowed to claim any right to interfere with the management. For instance, the drawing classes of MM. Levasseur, ex-pupils of the association, for which payment is required are more numerously attended than the gratuitous lessons which the same professors give under the auspices of the association. Nevertheless, it appears difficult to abandon the system of gratuitous admission to which the public is accustomed.

8. That it would be desirable to impose on the pupils certain conditions of admission and regular attendance; but, though in the provinces, as at Charleville and Guebwiller, for instance, such conditions are possible, the case is very different in Paris; we have tried them and failed.

9. That it appears unnecessary now to augment the number of courses given in Paris; on the contrary, it would be better to have fewer and to improve the teaching.

10. That the want of instruction is felt quite as much in the provinces as in the capital. Courses, some of which are professed under the auspices of the Polytechnic Association, already exist in several towns. It would be very easy to increase their number; and for this purpose efforts must be made to promote the formation of societies like those at Amiens, Lyons, Bordeaux, &c. In some places there would be no necessity for

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* In England and Germany powerful associations have been formed for the diffusion of knowledge among the artisan class without the aid of the Government, which is infinitely better; but we confidently assert, in spite of all that has been said to the contrary, that the manners and customs of those two countries are very different from those of France, and that time alone can modify ours. At Lyons, Bordeaux, Mulhouse, Amiens, Charleville, and Nemours associations of the same kind are being formed at the present moment, but in what other towns of France shall we find such resources combined with a spirit so enlightened and progressive.

public aid ; but when the need exists, it will be indispensable for the Government, or rather the local authorities, to lend the society a helping hand.

11. That these courses cannot have any chance of continued success without being, in each locality, under the direction and superior inspection of a morally responsible director. This director ought naturally to be the president of the society ; * and he should not only possess the authority arising from an independent position, previous services, and zeal for the popular cause, but he ought likewise to be supported by having buildings or subventions placed at his disposal by the Government or local authorities. His influence would be further increased if all rewards, such as decorations and academic palm leaves, were awarded only on his recommendation or on that of the standing committee over which he presides. Men well fitted to fill the office of president would be more easily secured in the departments than is generally supposed ; they would be found among engineers of mines, engineers of bridges and roads, pupils of the Central School, manufacturers, merchants, &c.

12. That the Minister of Public Instruction, or his General Secretary, ought occasionally to visit the provincial towns to preside at the distribution of prizes and to give honorary recompenses to the professors, as well as the pupils, in the Emperor's name.

Under such conditions we are convinced that excellent courses for adults might be easily established, without any great expenditure, in the commercial and manufacturing centres of the provinces.

Lectures.

Success of the public and gratuitous lectures.

The public and gratuitous lectures which we established in Paris for the working class some five years since have been very successful ; they have had numerous imitators, and the Minister of Public Instruction has given us an undeniable proof of his sympathy with our efforts by instituting during this last year similar lectures at the Sorbonne.

Number and object of the lectures.

No one professor ever gives more than two lectures, each from an hour to an hour and a half in length. It would not be possible in that time to teach the sciences in detail.

The sole object of these lectures is to show the utility and the beauty of science by setting forth its most remarkable results, and thus attracting people to the courses where more extensive knowledge can be attained. The lectures are thus a kind of prospectus for the practical courses.

The lectures of the Polytechnic Association are generally given every Sunday in the fine season, from April to July, when the courses are closed.

Names of professors.

The professors are not those who give the courses. Most of them are men who have made themselves a name in the scientific

* At Lyons the director is an eminently practical man, M. Girardon.

or literary world. Among them we may mention Messrs. Babinet, Geoffroy Saint-Hilaire, and Paulin Paris, of the Institute; Drs. Trousseau and Bouchardat, of the Academy of Sciences; M. Ferdinand de Lesseps, president of the Suez Canal Company; M. Philarète Chasles, and M. Saint-René Taillandier, professors at the College of France; M. Edouard Thierry, administrator-general of the Théâtre Français; M. Samson, professor at the Conservatory; M. Barral, of the Agricultural Society; M. Jules Duval, of the Geographical Society; MM. F. Passy and Batbie, professors at the School of Law; M. Homberg, engineer-in-chief, director of the bridges and roads; M. Eugène Flachat, engineer-in-chief of the Western Railway; M. Aug. Perdonnet, president of the Polytechnic Association.

Subjects treated.

The subjects treated are very diversified. M. Babinet spoke chiefly on the state of the earth before the geological periods, on volcanoes, earthquakes, and the progress of the physical sciences; M. Geoffroy Saint-Hilaire on acclimatization; M. Paulin Paris on the state of popular education in the middle ages; Dr. Trousseau on empiricism; Dr. Bouchardat on the influence of alcoholic beverages on health, on milk as an article of food, and on sanitary science for the working class; M. Ferdinand de Lesseps on the improvement of the condition of the labouring class in Egypt; M. Philarète Chasles on self-made men and on improving the condition of the working class; M. Saint-René Taillandier on the state of literature in the time of Rotrou (1609 to 1650); M. Ed. Thierry on the influence of the theatre on the people in general; M. Samson on elocution and the beauties of the French classics; M. Barral on the Paris Agricultural Exhibition, the International Exhibition, and on the state of the atmosphere; M. Jules Duval on the advantages and disadvantages of emigration for the people, and on our principal colonies; M. Félix Passy on the influence of machinery on social progress; M. Batbie on credit and provident institutions founded for the benefit of the working class; M. Homberg on new bleaching processes; M. Eugène Flachat on steam navigation; M. Perdonnet on the history of railways and their influence in promoting civilization, on great inventions, and their influence on the condition of the labouring class, on the great works executed for carrying railways over wide rivers and high mountains.

We have always carefully avoided, as will be seen by the above, authorizing professors to treat of subjects which might give rise to political or religious discussions.

Number of hearers.

The audiences at all these lectures have been numerous. It is seldom that the great amphitheatre of the School of Medicine, where they are given, has not been completely filled, although it holds from 1,200 to 1,500 persons. At the first lecture given by M. de Lesseps, the crowd was so great that above 2,000 persons were unable to obtain admission. M. de Lesseps promised a second lecture for the following Sunday, to begin at two o'clock; but as the amphitheatre was quite full an hour before the time fixed, M. de Lesseps began his lecture, and finished it at two. The audience then retired, and ten minutes later he re-delivered

the same lecture to another full house. Had he not been fatigued, he might have found a third audience of persons who had not been able to hear the first two lectures. M. Samson's lecture was also an extraordinary success.

Character of the audience.

The persons present on these occasions belonged to all classes; some have asserted that the working classes formed a small minority. The fact is that we cannot now distinguish workmen by their dress; but we certainly recognized a great many who had attended our courses and obtained prizes there. There were, on several occasions, a good number of ladies, for whom seats were reserved near the platform.

Expenses of the lectures.

The amphitheatre being granted freely for these lectures by the Faculty of Medicine, and the professors receiving no remuneration, the expense attending these lectures, which are always given in the daytime, is very trifling.

Lectures in the departments.

We have already tried similar lectures with success in the provinces. Two years ago, during the Exhibition at Metz, we delivered, in presence of an audience of at least 1,200 persons, the lectures on railways given in Paris the year before, and we have promised to give others this year. Several professors have successfully followed our example. At Lyons and Charleville we have lately commenced lecturing to audiences as numerous and as attentive as those of Metz. We have also been requested to give lectures at St. Etienne, Orleans, and other towns, but our numerous occupations have prevented us doing so.

We are convinced that if the Government were to obtain free passes by rail for the gentlemen who might be disposed to diffuse knowledge in the provinces by this means, that many would offer themselves for the work, and would be well received everywhere. We have no doubt that the railway companies in general would readily grant free passes for professors at the request of the Government. The Government, of course, would confer this favour only on men possessing its confidence, and on condition that they should treat only of subjects which could not excite angry passions.

Libraries for the People.

Popular library founded 25 years since by the Polytechnic Association.

Public libraries are an excellent addition to gratuitous courses of instruction. The Polytechnic Association founded one about 25 years since, at the Halle-aux-Draps. It was placed under the management of an ex-pupil of the Polytechnic School, and of the professors, who guided the pupils in the choice of books. This library, being open only for the pupils of the association, and the books not being allowed to leave the premises, met with but little success. It was burnt in the fire which destroyed the building. About the same epoch, M. François Delessert conceived the design of founding a popular library in each quarter of the capital, but the project was never realized.

Library founded by working men.

Three or four years since a certain number of working men united for the purpose of forming in the third arrondissement a people's library on a new plan, and did us the honour of soliciting our co-operation as president of the society. The statutes

this society, approved by the Minister of the Interior, authorized the calling of general meetings whenever necessary, and intrusted the management to a committee of 30 members, half of whom only were to be of the working class. The president and the committee were named by the general meeting.

The defects of this organization soon became apparent. The 15 workmen were very punctual in attending the meetings of the committee, the other members were generally absent. The 15 artisans, for the most part well-meaning men, but unused to the conduct of affairs, rendered the discussions long and tedious. At one of the first general meetings at which we presided, the committee proposed to appoint as honorary president the mayor of the arrondissement, who had kindly granted us the use of the mayory. The discussion on this motion was very calm and well-conducted, but the majority, influenced by persons not belonging to the working class, rejected it.

Organization imposed by the authorities.

After this meeting, the Prefect of the Seine withdrew from the *Society of the Friends of Instruction* the use of the hall of the third arrondissement, and the Minister of the Interior revoked the authorization given to the statutes. For three months the operations of the society were totally suspended, but after that interval it was reconstituted on the following bases :—The society is to be managed by a president selected by the Minister of the Interior and a committee proposed by the president and approved by the same minister. The mayor is *ex officio* honorary president, and is to be present at the general meeting, which is held every year under the supervision of the authorities, to hear the report of the society's operations. The catalogue of the books in the library must be sent to the minister whenever he requires, and must be approved by him.

Present condition.

The *Society of the Friends of Instruction* thus organized still exists, and works well; the number of members exceeds 400. The subscribers pay a very small yearly sum which suffices for working expenses. They are allowed to take books home on certain conditions prescribed by the regulations.

Fears were entertained that the books would not be returned, and, in a town like Paris, it would be difficult to prosecute those who kept them. Experience has proved that these apprehensions were groundless. Women are admitted to subscribe as well as men.

Founding of other similar libraries.

The Polytechnic Association is now engaged in founding two similar libraries, one at Ivry, with the aid of Colonel Collard of the Artillery; the other at Vincennes, with the co-operation of the mayor and of M. Leroyer, vice-president of the association. In several quarters of Paris libraries of the same kind are already opened or soon will be. In the departments the number of libraries increases every day.

Itinerant libraries.

M. Hachette, the well-known publisher, has had the happy idea of lending to these libraries boxes of books, which, after being read in one town or village are removed to another. These are what have long been known in England as *itinerant libraries*.

Necessity of Government supervision.

The founding of popular libraries may render great services; but to prevent them from being turned to improper purposes careful supervision must be exercised over the choice of the books. Unfortunately there is too great a tendency in France to introduce politics on all occasions, even at the risk of compromising useful institutions. The Polytechnic Association is indebted for its success to the extreme care with which it has abstained from such a course under the different governments that have succeeded each other during the last 34 years.

AUG. PERDONNET,
President of Polytechnic Society.

ACCOUNT OF THE INSTITUTIONS FOR TECHNICAL INSTRUCTION ESTABLISHED BY THE MESSAGERIES IMPERIALES STEAM NAVIGATION COMPANY AT LA CIOTAT.*

The report is made at the request of the Minister.

The eminent chief whom we have lost, and whom in our own interest we still regret, though his eminent talents are now devoted to the service of the State, has expressed a wish to know the opinion of the committee on the all-important question of technical instruction. This personal souvenir, and new proof of esteem on the part of his Excellency the Minister of Public Works, are certainly the highest honour and the noblest reward which our humble committee could receive for the little good it has been able to do under the paternal auspices and direction of the company. Accordingly, notwithstanding the deep conviction of our inferiority and incompetence, we have not shrunk from the duty of responding to the appeal thus made to us.

Division of the subject.

The subject on which our opinion is required may be divided into three distinct heads. The first comprises a full statement of what the Company of the Messageries Impériales has done at La Ciotat in the interest of its dependants, and especially for supplying its workmen with the means of acquiring or extending their technical instruction. The results obtained in improving the moral and intellectual condition of the workmen, as well as the success of the company's works, and general organization of the enterprise, will be the object of the second part. In the third part, we shall give our opinion on the measures to be taken to establish or develop technical instruction, whether in the workshops or elsewhere.

ACCOUNT OF THE INSTITUTIONS FOUNDED OR AIDED BY THE COMPANY FOR THE BENEFIT OF ITS WORKMEN.

Ever since it entered on possession of the workshops at La Ciotat, the company has been earnestly occupied with everything

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* By the Committee of Management of the Relief Fund of the Messageries Impériales.

that could promote the moral and physical welfare f its workmen. It selected one of the directors, who was at the same time inspector-general and the person best fitted for the duty, we mean M. Béhic, to visit La Ciotat and study on the spot the best means of carrying out its intentions. To this epoch may be traced the origin of the different institutions which have exercised such remarkable influence on the welfare of the workmen and have also done so much honour to the company.

Infant school.

The solicitude of the company extends even to the children of the workmen, however young they may be. An infant school managed by the nuns of the Holy Name of Jesus is maintained at its expense; 75 of the children belonging to the most necessitous families are admitted gratuitously. The others pay one or two francs per month. For five centimes (one halfpenny) per day the nuns give a basin of soup at noon to the children of those parents who wish it. Children are admitted when two years old; boys remain till seven, and girls till eight years of age. They are taught the catechism of the diocese, sacred history, reading, the elements of grammar, of arithmetic, of geometry, and of geography; and the girls also learn to sew.

In winter the infant school is less numerously attended than in summer; the maximum of pupils is 260. This number appears very small considering how numerous the workmen's children are. The lady directress of the school speaks highly of the general conduct of the pupils. With regard to habits of cleanliness, the boys are not all that might be wished, and the girls are rather careless; however there is a great improvement in this respect as compared with a few years past. The children are nearly all able to read when they leave the asylum; but the girls far excel the boys in application and progress.

Primary school for boys.

A benevolent native of La Ciotat, M. Besson, has endowed the town with the institution of the Christian Brothers. For this purpose he bequeathed a house for the school and lodgings for the teachers and also a capital of 36,000 fr. for its maintenance. As the interest of this money is only 1,500 francs, it is barely sufficient to maintain two teachers and leave 300 fr. for incidental expenses. The company determined to assist the school by providing 1,200 fr. a year for the maintenance of the two brothers on condition that they should hold classes three hours daily for the apprentices employed in its workships. In addition to this pecuniary aid, the company also gives assistance in kind, as in repairs and appliances for the school, supplying gas for the evening classes, prizes for distribution among the pupils, &c. The value of the aid thus afforded was at least equal to the grant in cash.* The municipality also gives the brothers 400 fr. yearly for their own school, and has also intrusted the communal school to their care, for which it allows them 600 fr. a year, besides paying the rent and other charges.

* There are in all seven brothers, receiving together 3,100 fr., out of which they have to pay the taxes and the repairs of the house bequeathed to them; this last is perfectly distinct from the communal school.

The brothers' establishment and the communal school have altogether 350 pupils. These two schools, to which may be added two private schools one with 20 to 25 pupils, the other with 17, were, only a few months since, the only resources which La Ciotat, the chief town of a district containing at least 10,000 inhabitants, possessed for the education of boys.

There has recently been established a school for primary and secondary instruction under the patronage of the Bishop of Marseilles, and it has already 40 pupils. Some years ago the municipal authorities solicited the authorization to found a communal college, which was duly granted by an Imperial decree, but nothing has yet been done towards realizing the project.

The nuns of the Holy Name of Jesus, who manage the infant school, also keep a primary school for girls. The company does not make them any grant, but is always ready to tend its aid when necessary, for ornamenting the chapel on occasions of great solemnities, and in making the arrangements required at the distribution of prizes. The number of pupils attending this school is 123.

Besides the primary school, the nuns of the Holy Name of Jesus have a boarding school with 34 pupils, and a day school with 39. There are likewise in the town two private schools for girls, one with 25, the other with 83 pupils.

Apprenticeship.

Apprenticeship in the company's workshops is really the practical learning of an industrial profession, as well as an institution for the assistance of the company's artisans. In fact, with some very few exceptions, the apprentices are the workmen's children. From the time of their admission they are exclusively employed in learning the trade they have chosen, and are never sent on errands. The workmen are well disposed towards apprentices, whom they know to be the children of their comrades, and the foremen, for the same reason, take good care of them.

Not only is there no compulsory period of apprenticeship for the purpose of compensating the company for teaching them a trade, but as soon as admitted, even while mere children and for the most part unable to be of any use, they receive 50 centimes per day, which is soon increased, so that at the end of the first year it is generally a franc or 1 fr. 25 c. per day. The average pay of all the apprentices is from 1 fr. 30 c. to 1 fr. 35 c., so that workmen who have sons soon find them a help rather than a burden. There is, for instance, one workman who has five children, three of them are in the workshops, and their daily pay added to the father's makes a total of 12 fr. 25 c., or above 300 frs. a month without counting their father's overtime. This is more than a mere competence.

School for apprentices.

As already stated, 13 is the age at which boys are admitted into the workshops. It is very unusual for one to be admitted at 12, and no exception has ever been made for boys under that age. In conformity with the provisions of the law of 22nd March 1841, relative to the employment of children in manufactories, all the apprentices under 16 years of age go to school, one having been established on the premises expressly for them under the

management of the Christian Brothers. The apprentices are divided, according to their proficiency, into two classes, each of which is taught for an hour at a time, which, according to the law above mentioned, is deducted from the 10 hours of the working day.* The subjects taught are adapted for pupils who have received a minimum of elementary primary instruction. At the end of the year the company gives medals to those pupils who have most distinguished themselves.

School for female apprentices.

The school for female apprentices under 16 years of age is kept, as well as the infant school and the girls' primary school, by the nuns of the Holy Name of Jesus. As in the case of the boy apprentices, the classes are kept in the working hours. The number of girls who attend them varies from 10 to 15; they receive an elementary primary education.

Evening classes for primary instruction.

Evening classes for primary instruction were opened on the 1st October 1863. Various circumstances beyond the control of the company had delayed the opening of these classes; 180 workmen and apprentices had entered their names as pupils, but the room was too small to admit more than 72; and of these 10 have already withdrawn, owing to the inconveniences attending the organization of the classes and the difficulty of remedying them.

There is a great difference in the proficiency of those who attend or wish to attend these classes; some can only read and write very imperfectly; others have scarcely any knowledge of grammar, and perform the first operations mechanically. The forwardmost know a little of the elements of grammar and of arithmetic. It would therefore be indispensable to divide those who attend the classes into four sections at least. An unfortunate circumstance prevented the possibility of dividing them into more than two. A destructive fire burnt down the joiners' workshop and seriously damaged another building in which the drawing class was held. This class, being necessary for the candidates for employment as pupil-engineers on board the company's steamers, was removed to the rooms where the adult classes were held, and alternate with those classes; therefore, as the course of drawing was held every night from 8 to 10 o'clock, the classes of adults could meet only three times a week. The first section consisted of 12 to 15 pupils only, and their progress was very satisfactory. The case was different with the second section; the master was obliged to teach slowly that all the pupils might be able to profit by his lessons; but the consequence was that he advanced too slowly for the more proficient and yet too fast for the others, which was unfavourable to the progress of all, and a certain number withdrew in consequence. But this is only one of the difficulties attending all beginnings, and will certainly be surmounted ere long.

* The working day of 10 hours is divided into two parts of five hours each by one hour's rest in winter and two hours' in summer. The classes for apprentices are held morning and afternoon during the first of the five working hours. On arriving the pupils go at once to the schoolroom, and thence to their respective workshops.

The drawing course is given in the evening, as already stated, three times a week, from 8 to 10 o'clock; it comprises linear drawing of machines and naval constructions, and also drawing of ornaments. This course has been in existence ever since the company took the workshops. The hall used for the purpose will accommodate 102 pupils; this number is always complete, and if all the candidates anxious for admission could be accommodated there would be more than twice as many.

We know not which to admire most—the eagerness of married men and youth to attend this course, their application, or the order and silence which prevail in the hall. The results of the course have always been most gratifying. The reason is that the utility of drawing is fully appreciated as well by the apprentices and the workmen who wish to attain great skill in their craft as by the workmen who aspire to the career of engineer on board of the company's steamers. In fact nearly all the persons employed in this capacity are pupils who have followed this course of drawing and have been appointed after examinations to which none but workmen and apprentices in the company's workshops and pupils of the Schools of Arts and Trades are admitted.*

Course of the English language.

The organization of the Indo-Chinese line of steamers called attention to the utility of learning the English language. Accordingly a course of three lessons per week was established, but very few of the apprentices or workmen have yet thought proper to attend it; nearly the whole of the expense has therefore been defrayed by the company.

Library.

A literary and scientific library has been formed for the use of all persons employed in the workshops. It is open from 8 till 10 every evening, and on Sundays from 10 a.m. till 4 p.m. It is assiduously frequented by some of the workmen and apprentices, but their number rarely exceeds 25 or 30.

Bands of music.

Two bands of instrumental music are patronized and aided by the company. One of them, recently formed, is composed exclusively of 66 artisans and apprentices from the workshops. The other band, which is much the best, is composed of 36 musicians, one-seventh of whom do not belong to the workshops. These bands meet for practice in the evening, one of them on the company's premises, the other in a room belonging to the Christian Brothers' school. The emulation, nay almost rivalry, existing between these bands is very favourable to their progress.

Youths' amusement society.

At the instance of the Bishop of Marseilles a youths' society which has long existed at Marseilles has founded a branch establishment at La Ciotat. Its object is to provide for young people all the pastimes and diversions of their age; none but boys of good character are admitted. The company was well pleased to encourage this enterprise, which seems likely to be attended with very satisfactory results.

Workmen's houses.

With a view to providing its workmen with salubrious and convenient lodgings, and to prevent them from being oppressed

* At the end of every year the company distributes silver and bronze medals to the pupils who have most distinguished themselves.

by excessive house rents, the company has built model lodging houses (*cité ouvrière*), which consists for the present of 24 detached houses in four rows; they have a ground floor and one upper story, with four sets of lodgings on each. Those on the ground floor have each a separate entrance and a small garden.

Some of the house are larger than others. In the larger, each lodging comprises a kitchen, which also serves as a living room, a chamber with two windows, a recess for the bed and closet, and lastly a small bed room with one window. In the smaller houses the lodgings are the same, except that they have not the one-windowed chamber. Every lodging has a wood house outside and a privy. In the middle of the city there is a cistern supplied with water by a pump worked by one of the engines in the shops. The streets of this *city* are wide and airy; the middle one and the avenue are planted with trees.

These lodgings are eagerly sought after by the company's artisans, and are never unoccupied. The rent is 100 fr. a year for the larger lodgings, and for the smaller 72 fr. to 65 fr., according to their position. The rent is either paid in advance or else deducted from the tenant's weekly wages.

Supply of meat.

Until 1855 the company paid an annual sum to a butcher in order to procure its workmen a good supply of meat at a cheap rate. At length competition in the trade rendered this arrangement unnecessary, and the grant was suppressed; but the butchers having soon after come to an understanding among themselves, prices again rose, and the meat offered was of inferior quality. A society was then organized to establish a butchery where good if not cheap meat might be bought. The company encouraged this effort by taking 20 shares. However, the price of meat (1 fr. 60 c. for beef and 1 fr. 75 c. for mutton per *kilogramme*) is still very high for working men. A scientific journal, *les Mondes*, having stated that good meat, not over-salted, might be obtained from La Plata at 50 c. or 60 c. per kilogramme, the company has instructed its general agent at Bordeaux to make inquiries on the subject, and, if desirable, to purchase a few hundredweights of such meat for the purpose of ascertaining its cost price, and whether it would suit the taste of the workmen.

Benefit Society.

All the persons employed in the company's workshops at La Ciotat form a mutual benefit society for the purpse of obtaining medical advice and medicines for each member and all his family, and also for each member when sick a daily sum ranging from 1 fr. 75 c. to 2 fr. 75 c. for those who earn above 2 fr. 25 c. per day. Those earning less receive an amount equal to two-thirds of their pay. No member can receive assistance longer than eight months, except in very rare cases. The three doctors settled in the town when the society was formed were all engaged, so that each member might choose the one he prefers. The lying-in expenses of members' wives are also paid out of the funds.

The society is managed, under the supervision of the company, by a committee, of which the directors and engineers are members

ex officio, in conjunction with three overseers and four workmen. The resources of the society consist of:—1. The payments made by each member, varying from 25 c. to 50 c. per week, according to the pay of the apprentice or workman. All who receive a monthly salary pay 1½ per cent. on it. 2. A direct grant from the company, the maximum of which, according to the rules, is fixed at 5,000 fr.; but this sum has been exceeded in years when the funds has shown a deficit. 3. Indirect aid from the company. For instance, the fund is relieved by the company's paying the whole salary for the first month of illness, and half of it for the second, to every engineer, foreman, or clerk who receives a monthly salary. Again, on the launching of every new ship, each workman or apprentice receives an extra day's pay on condition that he pays one half of it into the benefit fund. The payments of this kind have amounted to above 11,000 fr. in a year.

The money paid to sick workmen, with the cost of medical attendance and medicines for themselves and families, has always exceeded their contributions. This excess, as well as the doctors' salaries and the cost of management, is covered by the direct and indirect grants of the company and by the contributions of those members of the staff who receive monthly salaries.

Hospital.

Notwithstanding the advantages that would result for the patients themselves to be treated in the hospital, the mutual benefit society has been anxious to respect the instinctive repugnance which the working class entertain for that establishment. Nor has it ever deviated from this reserve except in cases when the sick member would be absolutely unable to receive proper attendance at home. Under such circumstances it has compelled the sick member to enter the hospital under pain of losing his claim on the sick fund. They soon find reason to be satisfied with the obligation thus imposed on them, thanks to the devoted, intelligent, and skilful treatment they receive at the hospital. The workmen treated at the hospital are not a burden to that establishment; the workshops relief fund pays the charge fixed by the managers of the hospital, which is at present 1 fr. 10 c. per day for working men.

Results obtained.

This part of our study naturally subdivides itself into three sections. We have to ascertain the results of the institutions founded or partially supported by the company, not only on the intellectual and moral welfare of the workmen and apprentices, but also on the works and general organization of the company.

Results on the intellectual improvement.

The institutions founded or assisted by the company for improving the education of its workmen, their families, and its apprentices, are far from producing all the good effects that might reasonably be expected, and the results do not altogether correspond to the efforts made. Notwithstanding the first germ of education received in the infant school, it is a melancholy fact that our apprentices, who are rarely admitted till 13 years

of age, do not possess the indispensable minimum of elementary primary instruction. None of them know our legal system of weights and measures, not even numeration; the four simple operations of arithmetic are performed mechanically; orthography and grammar are almost totally unknown. This deplorable state of affairs has two principal causes: the utter inadequacy of the means of teaching at La Ciotat, and the indifference of parents, as well as the absence of supervision on their part.

We have already said that the population of La Ciotat must now exceed 10,000 souls. A census carefully taken in the workshops in the beginning of 1863 gave the following results:—There were 956 wives, 687 boys, 780 girls, and 213 relatives; making in all 2,636 persons dependant on 2,314 workmen and apprentices, or altogether a population of 4,950. On the 1st of March last the total number of hands employed was 2,782; taking for basis the results of the census of 1863, the whole population dependent on the workshops will be 5,950.

To this number must be added the engineers, heads of offices, and workshops, clerks, and foremen, with their families; it is therefore certain that the total population of the town exceeds 10,000. Assuming this number to be correct, and calculating on the basis of the census above-mentioned, the number of children of all ages will be:—

	Boys.	Girls.	Total.
Under 2 years	335	539	874
From 2 to 6 years	1,005	1,059	2,064
From 7 to 12 years	830	886	1,716
From 13 to 16 years	399	481	880
Above 17 years	399	405	804
Total	2,968	3,370	6,338

The number of boys between 7 and 16 years of age is then		1,229
Deducting apprentices between 13 and 16 years	130	178
And boys gone to sea	48	
We find the number who ought to attend the schools		1,051

The following are the numbers we have already given as attending the primary schools for boys:—

Christian Brothers' school	100
Communal school	250
Two private schools	42
School patronized by the Bishop of Marseilles	40
Total	432

Deducting this number from the above total of boys between 7 and 16 years of age, we find there are 619 who do not go to school.

If we take into account only the boys from 7 to 12 years of age, we shall see that not more than half attend school; but even this half is very irregular. The most trifling pretext serves to keep them away. The Brother director assured us that sometimes not more than five boys are present in a class of *100*.

This irregularity is, of course, enough to prevent any progress being made. The teacher naturally wishes all his pupils to keep pace with each other. He therefore constantly repeats his lessons for the laggards, who do not profit thereby, and by so doing he discourages those who have previously heard the same lessons and know them well. The three years' schooling which our apprentices receive serves at the most to keep them from *forgetting* the little they knew on entering. Going to school has hitherto been regarded by the boys only as a disagreeable task, to be avoided whenever practicable. On the other hand, the parents in general set no value on education. They never think of compelling their children to attend the schools or of encouraging them to *study*; the consequence is that the streets are always swarming with children, who there acquire many bad habits, even that of gambling. Here, too, we find the cause of the *deplorable* ignorance exhibited by our apprentices.

As a general rule, the girls evince more intelligence than the boys. This difference is especially perceptible in the infant school. The girls there are far more proficient than the boys of the same age, but after leaving that school their education is just as much neglected by the parents as that of the boys.

The elementary evening classes in the workshops are of too recent date and the circumstances attending their *opening have* been too unfavourable to allow of appreciating their results. All that we can say as yet is that they are necessary, that they may become useful, and that the eagerness we have observed to attend these classes and those for drawing proves that the value of instruction is beginning to be appreciated, at least by those who aspire to be mechanicians or to become skilful in their profession.

The drawing-classes have been very successful. They have already turned out a good number of clever copying draughtsmen, well able to make plain or tinted drawings. We have likewise trained a still larger number who, without having any great facility with the pencil, can thoroughly understand a design and are able to make sketches of parts of machines to serve as working drawings.

Results on the moral improvement.

We have reason to believe, and are happy to proclaim the fact, that the moral character of the working population of La Ciotat will bear comparison with that of any manufacturing centre. The commissioner of police, the justice of the peace, the gendarmerie, and the public prosecutor all confess their astonishment at having so few offenders to prosecute. The honour of this state of things is chiefly to be attributed to the generous and elevated sentiments of the company's board of directors, as mani-

fested in the institutions we have enumerated. The workmen are well acquainted with these sentiments. They know that the directors, the heads of workshops, in short all those who take part in the action of the company, in their respective capacities, are actuated by the same feelings. They are convinced of the interest taken in their well-doing and of the solicitude to promote it. They show their gratitude by their conduct. The mass of the working population is excellent: it absorbs the migratory artisan, if he be honest and skilful; if otherwise, he soon finds the place will not suit him, and resumes his wanderings.

Three indisputable facts clearly show the moral condition of the workmen of the Messageries Impériales and its influence. In 1858 there was not a single steamer either building or under repair at Ciotat; consequently work was scarce. The effective staff of the workshops, though gradually reduced to 900 men and boys, was still too numerous. To avoid discharging more hands, and thus increasing the distress, it was proposed that all should suffer alike by reducing the working hours one-third; and this was done without exciting a murmur. In 1862 the working mechanicians of Marseilles struck for an increase of pay. They sent emissaries to La Ciotat to persuade the workmen of the Messageries Impériales to follow their example, but the latter refused to listen to these suggestions, confiding in the honour and justice of their employers to increase wages when such a course should be practicable. These two facts clearly prove the truth of our assertion respecting the moral character of the men employed in the workshops at La Ciotat. The following shows the effect of the spirit prevailing there.

We have already stated that the apprentices in the school are divided into two classes. Those of the second class, who are the youngest, are far from behaving as they ought in school hours. They frequently incur punishment, and some have been turned out of the school, and afterwards discharged from the workshops. Nothing of the kind ever happens in the first class; the pupils all behave well, and not one of them has incurred any punishment for a long time past. This difference is not due to the age of the pupils alone, but to the fact that the apprentices in the second class have but lately entered the workshops, while those in the first have been there for a considerable time, and have naturally felt the influence of the atmosphere in which they are placed; they feel the importance of keeping their places, and well know that to be impossible unless they behave well. Hence their constant efforts to correct their failings, and the improvement consequent thereon.

Results on the works and general organization of the company.

But the institutions founded or encouraged by the company have not proved beneficial to the workmen alone. The regularity and assiduity of the workmen, their attachment to their shops, and the order which prevails therein, are most favourable to economy and the good quality of the products. The remarkable constructions executed at La Ciotat both do honour to the eminent director of the works, and also attest the merit of his assistants and of those placed under his orders. Certainly no

small credit is also due to those who ply the hammer and the file. Though the schools of primary instruction have not produced the results that might be expected, they have at least helped to cultivate the intelligence of the artisan, and thus increase his skill. In this respect the influence of the drawing class has been very perceptible. We have said that a considerable number of the workmen who attend this class have become well able *to understand* a design, and even to make sketches to scale *that may be* used as working drawings. The consequence of this skill among our industrious and intelligent workmen is imperfect work in the execution of the detached portions of machines made at La Ciotat is extremely rare. The difficulties of this execution, inherent to the nature of the work itself, are still farther increased by the peculiar requirements of the company's service. A *great part* of the work now executed at La Ciotat *consists of detached* portions of machines intended to repair steamers stationed in the Black Sea or on the Brazilian and Indo-Chinese lines.

Another essential result, already mentioned, is the training in these workshops of nearly all the engineers employed on board the company's steamers. On leaving for their new functions these young engineers possess the manual skill, the mechanical knowledge, and the excellent spirit acquired there.

Besides this, all the company's overseers and foremen are trained in its own workshops.

On the whole, we are convinced that the institutions we have described have been beneficial to the workmen. The question whether the company has or has not been benefited by them can best be answered by the directors.

On the Means of establishing and extending *Technical* Education in Workshops or elsewhere.

Apprenticeship.

In commencing this part of our task, the first thing we have to decide is the precise sense to be given to the expression "technical education." We think that it cannot be taken to mean the practice of a manual trade. That is properly the object of apprenticeship, and cannot be taught in a school, for there must be as many divisions, with all the requisite appliances, as there are different crafts.* There is no occasion for any change in this respect in the workshops at La Ciotat. The apprenticeship is there conducted under the most favourable conditions, and with all possible completeness.

Programme of technical education.

We have come to the conclusion that by technical *education* should be meant the teaching of things necessary for every person who intends to follow an industrial or agricultural occupation. It is evident that the knowledge required must vary for each individual according to the particular branch he may take in each business. For the workman less is necessary than for the foreman, and for the foreman less than for a manager or engineer.

* In the Schools of Arts and Trades, where manual work is taught, the pupils learn only mechanical professions (forging, foundry, fitting, and joinery).

The instruction to be given to the workman ought, in our opinion, to be such as will raise his intellectual and moral level, facilitate the practice of his trade, make him more skilful in his craft, increase his powers of production, and consequently his own means and the common weal, by gradually suppressing the ignorance and vice which are the cause of so much misery and the ruin of families. In addition to the subjects taught in elementary primary schools, we think technical education ought to comprise:—Man's duty to God, his fellow creatures, and to himself; the study and recitation of select passages in prose and verse; calligraphy; the rules of French grammar and parsing; complete practical arithmetic; the elements of geometry; the elements of applied physics; industrial chemistry; industrial mechanics; linear drawing, applied to ornaments, machines, and naval constructions; the rudiments of sanitary science; the elements of history, especially of the history of France; the English language; the elements of geography, particularly as regards France; and gymnastics.

For the pupils who aspire to become foremen, heads of workshops, managers of factories, and engineers, the technical instruction, which we will call preparatory, must have the same basis as that for the workman, but be far more extended, so as to enable the pupils to enter a School of Arts and Trades or the Central School of Arts and Manufactures, which, for the working classes, may be regarded as schools of application, just as the School of Bridges and Roads, the School of Naval Engineers, &c. are for the upper classes.

Central School of Arts and Manufactures and Schools of Arts and Trades.

We think that with some improvements which experience may show to be necessary the Schools of Arts and Trades and the Central School of Arts and Manufactures are well organized, and fairly answer the purpose for which they were founded. For many years yet the instruction given in the former will be far above the average level of education of the working classes. Some few indeed of their best pupils rapidly rise from the humble positions in which they began their career to become engineers and managers of factories, and often attain great eminence. The greater number become skilful foremen, combining a competent knowledge of theory with practice. There are few manufactories of any importance in which pupils of these schools are not found. The same may be said of the railway services, the bridges and roads, and the steam navy. The company has at least 100 of them among the engineers on board its steamers, its foremen of workshops, and mechanicians.

The number of these schools appears to us sufficient, and instead of founding more we think the better plan would be to increase the number of pupils in those already existing.

Improvement to be effected in primary instruction.

The organization of elementary instruction has been settled by a law, the provisions of which are excellent. The only improvement required in the present state of things is that the law should be duly enforced, which is not yet the case in all places. At all events, ample provision has been made for the two extremes, the beginning and the finishing.

The intermediate instruction remains to be considered. In our opinion the first part of technical education, that which is more especially intended for workmen, should be given in every parish by the primary schoolmaster, and it would suffice, as a starting point, if the second part were given in the principal town of each canton. Both parts of this education must be placed under the supervision of the Government. Experience has fully demonstrated the necessity of this arrangement. Individual efforts have never produced any very satisfactory results in France.

The first part ought to be made compulsory in every town, the same as elementary instruction, and it must be effected in the same manner and by the same means. As for the second part, it might be left to private establishments, or to schools founded by the communes with a subvention from the State or from the Department, according to circumstances or localities, but always under the supervision of the Government.

Having thus come to the conclusion of the report demanded of us, we freely acknowledge, still more than at the outset, our incompetence to treat of the grave questions it involves. But we feel confident that his Excellency the Minister of Agriculture, Commerce, and Public Works will receive our work with his usual kind indulgence, and see a proof of our profound gratitude in what is only the accomplishment of a duty. We should be most happy if it could receive the adhesion of the directors of the company.

La Ciotat, 10th April 1864.

Signed by the members of the Managing Committee of the Relief Fund.

SHORT ACCOUNT OF THE SCHOOL FOR TECHNICAL EDUCATION AT THE GRAFFENSTADEN FACTORY.

Method of apprenticeship.

This factory procures most of its apprentices from among the sons of the peasantry in the commune of Illkirch-Graffenstaden (Bas-Rhin) and its environs, as well as those of its own workmen. To be admitted as apprentice the candidate must be 14 years of age, must be able to show by a certificate from the minister of his communion that he has been confirmed, and must also produce a certificate of good conduct signed by the local authorities of the town where he resides.

The term of apprenticeship ranges from four to six years, during which the apprentices are bound to attend the school for technical education annexed to the factory. After the first year those who distinguish themselves by their zeal and progress may receive, as an encouragement, daily wages, gradually increasing from 50 c. or 75 c. in the second, to 1 fr. 25 c. in the fourth year; in the two following years the wages are regulated by the capa-

bilities of the apprentice. Experience having shown that the school to be successful must not be altogether gratuitous, each pupil has to pay one-tenth of his earnings into the school fund.

Organization of the school.

The pupils of the school are divided into five classes, graduated according to proficiency, and all are taught by one master with the aid of the director and officials of the factory.

The following are the subjects taught:—Calligraphy. French and German grammar. Dictations and compositions in French and German. Free-hand drawing. Geometrical drawing. Drawing of machines. Arithmetic (logarithms, annuities, &c. included). Elementary geometry (including solids). Algebra (up to quadratic equations). Physics (theory of heat and acoustics included). Mechanics (simple machines).

The classes are held every morning from 6 to 8 o'clock (including Sundays, when all the five classes are united to learn drawing), and every evening from 5 till 7, except Wednesdays and Sundays; so that all the three lower classes have six hours' teaching, and the two upper ones eight hours' per week.

Evening school.

In order to give the pupils during the winter season every opportunity for self improvement, all who apply for permission are allowed, after their day's work, to repair to the schoolroom, which is lighted and warmed for their use, and a select library of instructive and interesting books is placed at their disposal.

Discipline.

The schoolmaster presents to the director of the factory a daily report respecting absent pupils, or other facts with which he ought to be made acquainted. The punishment to which the pupils are liable, according to the character of their faults, are a reprimand from the director, a pecuniary fine, or expulsion from the factory.

Examinations and reports.

Every month in the afternoon of the Monday following pay-day, in order to classify the pupils according to merit, there is an examination, partly oral, partly written (dictation, problems in arithmetic, and geometry), which is conducted alternately in the French and German languages. The results of this competition are communicated to the director and recorded in a register, which also contains an account of the marks obtained by each pupil. At the end of every quarter an abstract of this book is addressed to the parents of each pupil, thus enabling them to judge of the conduct, industry, talent, and progress of their children.

The monthly examinations are supplemented by a yearly one, which takes place in the presence of a commission composed of the higher officials of the factory. This examination is followed by a distribution of prizes (consisting of useful books), and no pains are spared to give all possible solemnity to the occasion.

Number of pupils.

About 300 young men have passed through the different classes of the school since its opening; the present number is 70.

Expenses.

The total outlay (master's salary, heating, warming, &c.) is 3,5000 fr. a year.

Results.

Taking into consideration the very little instruction the boys receive before entering the school, there is every reason to be satisfied with the results already produced and with its probable effect on the factory.

Those of the pupils who, being more especially favoured by nature (the smaller number, of course), are able to maintain themselves in the higher positions obtained at the early examinations are also those for whom the best places are usually reserved in the workshops and offices. With them the store of knowledge acquired in going through the five classes is sufficient, aided by study and constant intercourse with their superiors and with pupils, both French and foreign, who, having been educated in special schools, have come to Graffenstaden for practice, to extend the limits of their knowledge without the aid of other masters. Their efforts for self improvement are greatly assisted by the library of the factory which contains an excellent selection of the best scientific and technological works which have appeared in the French, German, and English languages.

The majority of the pupils, consisting of young men with less capacity, find in the school the elementary knowledge which, joined with experience acquired in the workshops or in the offices, prepares them to become competent foremen or skilful workmen.

Those for whom these studies have borne sound fruit, have at least the advantage of acquiring from my Master's lessons and from intercourse with their fellow-pupils those principles of order and morality which do honour to the working man.

LOUIS MESMEREN.

Graffenstaden,
27th February 1864.

ACCOUNT OF THE TECHNICAL COURSES FOUNDED IN THE IMPERIAL MANUFACTORY OF ARMS AT TULLE.

Courses professed.

By a despatch, dated 3rd March 1857, the Minister of War instructed the colonel inspector of the Imperial manufactories of arms to take measures for establishing at Tulle the same classes which already existed in the other manufactories. Consequently the colonel inspector on the 5th of May 1857 instructed the director of the Tulle manufactory to organize such classes.

The first session, entitled *Classes of arithmetic, elementary geometry, and linear drawing*, took place on the 20th of May 1857. Another class was subsequently founded by the director's order under date of 12th June 1860, and opened on the 14th of

the same month; this was entitled *Elementary class on the manufacture of arms.*

Attendance on these classes is compulsory on all the workmen proposed for promotion either in the manufactories of arms or as head armourers in the different army corps. They are optional for all the other workmen, but none are placed on the lists for promotion who have not attended them to good purpose. Pupils.

The special object in view in founding the classses was— 1. To give the heads of workshops and factories the instruction necessary to enable them without the aid of others to keep the daily accounts relative to the workmen under their orders. 2. To give the men destined to become controllers of arms or chief armourers to corps of troops a sufficient knowledge of elementary geometry and linear drawing to enable them, if called upon, to take the direction of workshops for the manufacture or repair of arms, or to superintend the working of machines in factories, and to keep the same in repair. Special object.

The classes are held three times a week at the head-quarters of the manufactory, and are taught by three officials of the artillery, one for arithmetic and elementary geometry, another for drawing, and a third for the manufacture of arms. Details.

The number of pupils is at the present moment 40, and has been nearly the same number since 1857; this number may therefore be considered as the average. The pupils are classed in two divisions; the first comprises those who have already attended the course, and have made most progress; the second, those less advanced, and new comers.

The classes for arithmetic and geometry are held after working hours, from 7 to nine in the evening; the drawing class every Sunday morning, from 8 to ten in winter, and from seven to ten in summer; for this class the two divisions are united. The most proficient draw all the parts composing small arms or designs of machines, and the others copy the various problems of geometry necessary for drawing the different parts of small arms, which have been previously demonstrated on the black board by the professor. All the courses are attended exclusively by workmen employed by the government.

The text-books used are *Course of Arithmetic and Geometry for the use of Non-commissioned Officers of Artillery*, approved by the Minister of War, Cirodde's *Lessons of Arithmetic*, and Bergery's *Course of Geometry applied to Industry*, for the use of artists and workmen. The drawing-boards, cases of instruments, rulers, squares, paper, &c. are found by the pupils themselves; the Minister of War allows a yearly sum of 90 fr. for firing, lights, and cleaning the room.

Programme of the courses.	Theory.	Application.
	Arithmetic.	
	Numeration of whole numbers and decimals Addition of whole numbers and decimals Subtraction Multiplication Division Fractions: Reduction to a common denominator; Addition and subtraction; Vulgar, transformed in todecimal fractions, and conversely Metrical system Problems on fractions Involution and evolution Proportions: Their properties and uses; Rules of three, direct and inverse; Fellowship; Alligation	In *all the daily* business of the workshops, accounts, calculations, &c.
	Elementary Geometry.	
	Definitions Straight line, curved line, angles and their measure, perpendicular and oblique lines Parallel lines and their combinations with perpendicular and oblique lines The circle and its properties Plane rectilinear figures, their various forms, their properties, their relations to the circle Equality, similitude, proportionality of these figures Superficies of plane figures terminated by straight or circular lines	Indispensable for drawing geometrically the different parts of arms, making designs of machines, repairing and modifying them as required, and for measuring superficies.
	Linear Drawing.	
	Preliminary studies on the practice of drawing Instruments and their use Solutions and fair copies of the different problems proposed and solved in the geometrical course Drawing of the different parts of the infantry musket, after the tables of construction Sketches of machines with dimensions marked, from the very simplest, and making fair copies of the same	*Drawing* of machines on the spot. Description. Drawing from the tables of construction of the various parts of fire-arms. Drawing to measure.
	Course on Small Arms.	
	Study of the infantry musket Object of the principal parts composing it Forms, dimensions, weight, substances employed Conditions which these different parts must satisfy, and the reasons for them Historical sketch of smooth bore fire-arms Essential modifications till the adoption of the model of 1822 Successive changes till the adoption of the model of 1853.—Special study of this model Elementary remarks on rifling—its object Adoption of the model of 1857 General transformation of muskets into rifles Application of this transformation to all military fire-arms, except the pistols of the gendarmes	Taking to pieces and putting together of fire-arms. Examination of foreign arms and comparison with those of the French army.

The lessons are given under the direction of the sub-director; the director himself attends in person when his other duties permit, in order to stimulate the zeal of both teacher and pupils. By appointing all the former yearly, the teachership is made a means of instruction for the more capable officials; by changing them alternately from one course to another they are obliged to study all the subjects thoroughly, and everyone profits by this arrangement. Accordingly, the results obtained have been excellent, and there is never any scarcity of competent candidates for the offices of overlookers, head-armourers, foremen, or managers.

MAJOR E. FERNAND,
Director.

Tulle, 29th February 1864.

REPORT OF 1848 ON INDUSTRIAL EDUCATION.*

In the present state of affairs the Government takes no direct part in industrial education, except by means of the two kinds of establishments which belong to it, the Conservatory and the Schools of Arts and Trades; but it intervenes indirectly by the aid which it affords to certain schools founded by private enterprise, such as the Central School of Arts and Manufactures, the Ménars School, and some others of minor importance. No general idea has guided the formation of these establishments, which have been founded at different times and for distinct reasons; they have been developed in their particular spheres, retaining all the independence of their origin and destination.

There have been many complaints of this absolute want of coherence in a branch of instruction which, more than any other, requires to be graduated and modified according to the requirements of society. It does not suffice to give instruction to youth and to mere idlers; it is, above all, indispensable that it should be properly graduated, and applied to the progressive development of the intelligence and practical dexterity of the pupils, without ever exciting in them the pride of smatterers in science, and those exaggerated pretensions which seduce young men from a life of active and laborious industry into speculative and ambitious courses which can have no satisfactory result. Industrial education,—that is, special instruction to prepare youth for various industrial professions,—instead of being incomplete, and, as it were, abandoned to all the chances of individual enterprises or local associations, ought to be organized with a view to extending its benefits to the whole of France. This organization, systematic and regular, strong and liberal, embracing every degree, from

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* This report was drawn up in 1848, and presented to the then Minister of Agriculture and Commerce by a special Commission consisting of the Professors of the Conservatory of Arts and Trades.

the humblest apprentice to the highest class of engineers, can only be effected by the efforts of the Government.

Now, it so happens, that in this point of view, the State has not at present full liberty of action. At Lyons, Nantes, Marseilles, and many other manufacturing towns, there have been founded, either by munificent donations, or by private subscriptions, establishments independent of the Government, and intended to satisfy the wants of local industries more or less completely. At Paris, the Central School of Arts and Manufactures, which has for more than twenty years past undertaken the education of civil engineers for all France, and has rendered great services to the country, constitutes an establishment of the highest order, whose independence has been sanctioned by the State, and whose rights ought to be respected. Thus, in the intermediate as well as in the higher degrees of industrial education, the State finds the ground occupied and public requirements satisfied, not perhaps so completely and so regularly as they would be under its own authority, but still in such a way that it cannot think of founding rival establishments to compete with those already existing.

These circumstances have appeared to us of a character to limit the examination with which we are charged. We therefore thought proper to communicate with the Central School. The director and all the professors agreed to meet us, and we then plainly propounded the question whether the Central School wished to remain a private establishment as hitherto, or whether it would consent to become a Government establishment, under certain conditions. The Central School unanimously replied that, under present circumstances, it would prefer to retain its private character. This resolution of the Central School made us abandon the idea we had at first entertained of presenting to you a complete system of industrial education.

Being thus compelled to limit our inquiry so as not to encroach on any of the rights which the Government doubtless wishes to respect, we have directed our attention exclusively to industrial education of the first degree; for that of the second degree is too closely connected with the highest degree for the two organizations to remain distinct. However, after expressing our opinions on schools of the first degree, we will say a few words on the Schools of Arts and Trades, which, at least with regard to the age of the pupils, ought to be one of the branches of the second degree.

Trade Schools.

On leaving the primary school, the boy who wishes to learn a trade becomes an apprentice; the master will teach him, by degrees and practically what he has himself learned; in return, the apprentice will work for his master without wages during a certain term. If each master were capable of teaching his apprentice all the theory and practice necessary to make the youth a good workman, there would be no occasion for schools for apprentices; but, unfortunately, most of the masters have very

little theoretical instruction, which is the reason why nearly all the commoner trades remain almost stationary. To secure rapid improvements in all the kinds of work which occupy so many hands, we must supply what is wanting in the masters as regards theory, and profit by the experience and skill which they have acquired by practice.

The question being thus stated, we have no hesitation in admitting that theory ought neither to precede nor to follow practice, but that it ought to advance simultaneously with the latter, and in juxtaposition, since it cannot be incorporated with it, as if both were taught by the same master. We therefore propose that in all towns where the number of apprentices is sufficient, schools shall be established in which young men may attend as out-door pupils to receive the theoretical lessons necessary for their profession, either during the course of the day or in the evening: The professors who give this instruction must not, on any account, be men exclusively habituated to abstract learning, without being themselves joiners, cabinet-makers, locksmiths, founders, &c. It is indispensable that the practice of these different trades be familiar to them as well as the theory, so that the pupil may be able to obtain from his master the explanation of whatever difficulties embarrass him. The object would be completely missed if the pupil, in consequence of what he learned at school, did not become more attentive to his work in the shop, and more competent to understand the reason of the facts that come under his observation.

Success depends altogether on the choice of professors. We must not, however, overlook the fact that these schools, which we designate *trade schools*, on account of the object they have in view, will have to encounter serious difficulties. The first is found in the contract of apprenticeship, and the second in the boy's parents, who if in needy circumstances will, of course, want their son to earn his own living as early as possible.

The contract of apprenticeship, in a moral and economic point of view, is a very important matter, and ought to receive the special attention of the Government. We cannot here treat of all the difficulties connected with this subject, but we think that trade schools would have no chance of success unless effective measures were taken to have time for attending them expressly reserved to the apprentice by the terms of his indentures. The interest of families is too often an imperious necessity, absolutely requiring that boys should not pass too many years without receiving wages ; on the other hand, it is also necessary that the master should keep the apprentice long enough for his work, when he has attained some little skill, to compensate for the trouble given in the first year, when the novice not only rendered no useful service, but was even a hindrance. Now there is reason to fear that the compulsory reservation of school hours in the contract of apprenticeship will not be considered in a favourable manner by the masters. We are inclined to believe that going to school will, as a general rule, tend to shorten that unfortunate period during which the apprentice is a burden rather than a

benefit; but we can hardly expect that masters will entertain such an opinion till experience shall have repeatedly proved the fact. Consequently, we consider as certain that masters will not consent to the reservation of school hours without prolonging the term of apprenticeship. We therefore feel justified in declaring our conviction that *trade* schools will be viewed with dislike by both masters and parents.

The masters will be more particularly struck with two things; in the first place they will perceive that their own incompetence as regards theoretical teaching is considered as a matter of fact; secondly, they will see that the effective time given them by the apprentice would be diminished by two or three tenths, according as the school hours were two or three per day, and thus, instead of the usual three years' apprenticeship, they would require four to make up for the time which, in their opinion, would be lost at school. Parents will be alarmed at this further demand on the part of the masters, and whether well-to-do or otherwise will be likely enough to be frightened at the bare thought of seeing their children condemned to pass an additional year, or perhaps more, without earning a penny; pressed by poverty, a good many would doubtless decide on putting their children to those inferior trades which require but little if any apprenticeship, and are always over-crowded.

We see only one means of escaping from these serious difficulties. We hope that the Government will be able, in each of the towns now under consideration, to promote the formation of a benevolent association, having for its sole object the succour of apprentices of both sexes, and also of young work people; for it is to be hoped that ere long professional instruction will be extended to girls as well as boys. In a town of 5,000 or 6,000 souls, for instance, the patronage society ought to be composed of at least five or six of the most respectable inhabitants, and of a certain number of ladies, whose zeal and charity have everywhere so salutary an influence. This society would receive a certain subsidy from the Government, which, with the proceeds of collections and subscriptions, would be employed for the benefit of apprentices of either sex, in promoting their education and putting them apprentice to the trades best suited to their taste and their means of existence. Nothing connected with apprenticeship should escape the notice of the society in question; it might endeavour to arrange equitably by friendly intervention most of the difficulties arising between masters and parents on the subject of apprenticeship.

The establishment of patronage societies and trade schools appears to us so closely connected that we have no hesitation in proposing that the trade school should be directed and managed by the patronage society itself, and one of its members ought to keep all the accounts connected with the school. In accordance with this principle the teachers of the school, as well as the pupils, would be under the supervision of the society; the professors, however, would form part of the council in which all matters connected with the teaching would be treated, and

perhaps, after a certain number of years' incumbency in the town, would also be admitted to become themselves members of the society, but only as an honorary distinction in acknowledgment of good services.

The course of instruction in the school, of which we may give a programme at some other time, would comprise:

1. Arithmetic, with theoretical explanations of the principal operations, and practical arithmetic for the rules of three, interest, fellowship, and other applications, including the use of the sliding rule.

2. Theoretical geometry, so far as regards the elements of plane geometry, and practical geometry for solids, taking of plans mensuration of surfaces and solids, &c.

3. The rudiments of descriptive geometry as far as the generation of the commoner surfaces.

4. The rudiments of physics including specific gravity, atmospheric pressure, hydrostatics, pumps, &c., and also the branches relative to heat, thermometers, dilatations, the fundamental properties of steam, &c.

5. The elements of industrial mechanics.

6. Linear drawing, the elements of machine drawing, the simplest working drawings of descriptive geometry, applied carpentry, stone-cutting, and perhaps also drawing of the figure and of ornaments.

7. Dictations to improve the pupils in writing and orthography.

In towns with a population exceeding 10,000 souls, several schools would probably be required situated in different quarters, and the same professor might give lessons in several of them; it would be far better for the professors to go to different localities than to have the schoolrooms at a great distance from the pupils. On Sundays, or on one or two work-day evenings, there might be lectures for adults, that is to say, young men working on their own account.

The professors should not be entirely dependent on teaching for their living; we think their salary should be from 1,500 fr. to 2,000 fr. Being selected from among persons possessing all the instruction required for a civil engineer, they might render valuable services to the localities by devoting their attention to the manufactories in the neighbourhood. Two professors would, as a general rule, be sufficient for the smaller schools; but where the number of pupils was large, and a greater variety of manufactures existed, at least three professors would be necessary for each school, the better to adapt the instruction to local requirements.

The professors should receive part of their salaries from the State, and the remainder from the towns as well as the outlay for rent, furniture, warming, lighting. Supposing that the State contributes, on the average, 3,000 fr. for each school, for a total sum of 600,000 fr., 200 schools might be established, which would educate 20,000 apprentices, allowing 100 for each school.

Schools of Arts and Trades.

These schools render important services to the national *industry*, in many respects:—1. They every year turn out a considerable number of good draughtsmen for large workshops; those who are most industrious soon acquire the experience which was wanting on leaving the schools, and their theoretical knowledge greatly contributes to the improvement of the mechanical arts. 2. They distribute through the provinces a certain number of artisans skilled in working wood or iron. 3. They may become a valuable nursery for the marine by training engineers for steam vessels; but we think the pupils who choose that career ought, on leaving school, to pass a certain time in the workshops belonging to the State.

Such are, in a general way, the good results of the schools of Arts and Trades; but, apart from these principal heads, the pupils who aspire to other careers are not so well prepared for them; for instance, it is very seldom that those who enter the larger workshops as mechanicians are not disgusted with their choice after an experience of a few weeks or months. There are certainly noble exceptions, we well know, but they are only exceptions.

The disgust which comes over the great majority *is owing to* two causes, 1, to the fact that in the schools, with a *view to excite* their emulation, they are too often flattered with the hope that they may rise above the position of mere workmen, and that their theoretical knowledge fits them to be foremen; 2, that the mechanical works they can execute in the schools are, from the very nature of things, too limited for these young men not to find themselves inexperienced novices when they enter large workshops; yet they arrive full of confidence in their superior *attainments*, and are bitterly disappointed at receiving much lower salaries than those practical hands unacquainted with theory, over whom they expected to be placed from the very commencement.

We can see only one remedy for this serious inconvenience; it is not to suppress the mechanical workshop, but to dissuade the pupils, as far as possible, from seeking employment in large factories. We also hope that by restricting the professors within the bounds of a programme limited to what is strictly necessary, and eliminating from the curriculum all subjects of too abstract a tendency, we may succeed in exerting a most salutary influence in the future career of the pupils.

Conservatory of Arts and Trades.

It would ill-become the professors of the Conservatory to boast of the services they render or may henceforth render by their lectures. Yet there is one material fact to which they may be allowed to call the Minister's attention; it is that the new amphitheatre opened last year on resuming the lectures having enabled the professors to give their lessons at more convenient hours, the number of hearers has greatly increased; the two amphitheatres

have nearly always been not only filled, but found too small to receive all who came, and many were consequently unable to obtain admission.

The character of the instruction given, which is both public and gratuitous, industrial and agricultural, ought as we think to be scrupulously maintained; it has been received with such unanimous favour by the public that it has only to persevere in the same path, which appears to us that of intellectual progress.

When our new buildings shall be completed there will be a necessity for founding several new chairs, either for the agricultural sciences or for the industrial, properly so called; we deeply regret that the state of the public finances will not allow us to think of these foundations just now.

But there is another point to which we feel bound to call your attention. Seeing its character, its position, and the nature of the instruction given, the Conservatory does not seem destined to remain long in its present state of isolation from the establishments in which the other degrees of agricultural and industrial instruction are given; we conceive the possibility of its taking therein a useful and glorious share. We will not here pretend to indicate all the more or less intimate relations which ought to connect those various establishments with the Conservatory, but there is one which we feel bound to mention now, as it seems to us fundamental; it is the choice of the professors selected to take part in the different steps of agricultural and professional instruction. The first duty of the professors of the Conservatory is to combine, with skill and judgment, all the resources of theory with the diversified requirements of practice. The highest merit of the professors of the schools in question will not be the possession of vast stores of literary or scientific knowledge, but rather the talent of blending theory in due proportions with practice; it would be vain to attempt to devise a programme with a view of obtaining such a result, if the professors be not endowed with certain habits of thought and teaching capabilities of which few persons are competent judges.

Special Libraries.

The different kinds of instruction mentioned in this report would be, in our opinion, greatly promoted in their more serious and essential parts if each school were provided with a special library, not very extensive, but well chosen, in which each pupil could find the books treating of the subject to which his studies are more particularly directed. We attach so much importance to this point that we intend very shortly to lay before you our reflections on the subject.

(Signed) Pouillet,
Reporter.

Paris, 17th July 1848.

ACCOUNT OF THE UPPER COMMERCIAL SCHOOL.*

SIR,

THE Upper Commercial School (*École Supérieure du Commerce*), of which you have been pleased to charge me with writing a brief history, has now been in existence forty-five years, and it claims with justifiable pride the honour of having been the first to enter on the path of professional education, in which it now has so many imitators. It was founded in the year 1820, in the Rue de Grenelle-St. Honoré, under the form of a day school, by two intelligent merchants, M. Brodard and M. Le Gret, and soon obtained the patronage of the eminent men who at that time took the lead in directing the progress of the country, Chaptal, Casimir Perrier, Laffitte, Ternaux, &c. It did not long retain its original form, and was, sometime after its foundation, transferred to the old Hôtel Sully, in the Rue St. Antoine, where it was installed in a manner worthy of its protectors, and thoroughly appropriate for its purpose. It then received boarders as well as day scholars.

The establishment of the School as a scientific institution, of a kind then unknown, presented great difficulties; its founders had to incur not only a pecuniary risk, and to unite in a methodically organized system of studies all the instruction that could be useful to a trader, but also to choose and train professors, to select and classify the subjects to be taught, and likewise to convince parents of the advantages their sons would derive from receiving the kind of education proposed. At that period few people could see, I will not say the necessity, but even the utility, or possibility of such instruction. Commerce, it was asserted, could not be taught on account of the multiplicity of the specialities it comprised; practical apprenticeship could alone teach the mysteries of trade to those who wished to learn them.

This objection, taken in an absolute sense, had something specious calculated to strike prejudiced minds habituated to routine. But it will not bear close examination, and if it be true that after studying all the sciences taught in the School of Commerce, a young man must serve a practical apprenticeship to each branch of trade ere he can learn its difficulties, dangers, resources, advantages, and secrets, it is none the less true that he who has been prepared by study will advance more rapidly and safely in the path, and that the means placed at his disposal by science will always, with but few exceptions, secure him an indisputable superiority. It was still denied that we Frenchmen possessed the qualities indispensable for commercial success, that the French mind was adapted for the slow combinations of foreign trade, that the impatient activity of our character could accommodate itself to the various changes of the speculation extending over long periods of time, on which the export and import

* Addressed to the Minister of Agriculture.

trade depend. The objectors forgot that our national mind, from the very fact of its being impressionable and fickle, wonderfully adapts itself to all modifications; that our French intellect, so quick, subtle, and comprehensive, contains the germs of all qualities, and that necessity developes them. The comparative customs returns, published at successive intervals in France, victoriously prove the truth of the arguments we here produce.

The obstacles encountered did not arise solely from prejudices of routine more or less easily vanquished, there were others, still more serious, in the very state of affairs. The country was but just recovering from the great wars of the Republic and the Empire, which had so long absorbed all its strength and over-excited its brilliant faculties. It was very difficult for the nation to return suddenly, and without transition, to the realism of manufactures and trade, to enter without some hesitation on what was then, with a kind of disdain, called the mercantile career. The youth of the middle classes of society, for whom the new establishment was especially intended, had a greater liking for the so-called liberal professions; they wanted to be barristers or physicians, and could not bear the very name of trade. Young men, almost universally, regarded the selection of a commercial career as a kind of degradation, an avowal of inferiority and incapacity; they spurned the notion that trade could deserve to be the object of earnest study.

It was under these unfavourable conditions that the school in the Hôtel Sully was organized as mentioned above. Large buildings, spacious courts, and an extensive garden were placed at its disposal; a cabinet of instruments for experimental physics, a chemical laboratory, and collections of samples of merchandise, were installed on a large scale; a numerous staff, perhaps too numerous, was formed; lastly, yielding to the popular prejudices of the day, the pupils assumed a uniform and wore a sword, while all the internal movements were announced by beat of drum.

By the side of this theatrical display, somewhat ambitious for a private establishment, and which was the work of its financial managers, a council of improvement (*conseil de perfectionnement*), composed of very competent persons, undertook to draw up a programme of the studies, to superintend their organization, to make modifications if necessary, and to enforce their execution. The gentlemen forming this council were members of the Institute, bankers, manufacturers, merchants, who had learned by study and experience what various talents and diversified knowledge are indispensable for him who buys, sells, or manages. They traced with a firm and sure hand the regulations and programmes of the new school. Their wise arrangements have been religiously retained in the school, and are in force to the present moment; they have served as a model and starting-point for all the attempts of the same kind which have been made in France or elsewhere. The council has constantly maintained the sound traditions of the school, and has been its main support.

The curriculum of the school requires three years of study; the pupils are divided into three forms (*comptoirs*) or classes, and

no pupil passes from one form to the next without undergoing an examination.

The first year, or first form, though in some manner elementary, admits only such pupils as have received a good primary education, and are pretty well versed in French grammar, arithmetic, and geography ; it is devoted to reforming their handwriting, to the study of history, geography, arithmetic in all its parts, to an elementary course on the usages of trade and the rudiments of accounts, to physics and chemistry, (of which the pupils in this form learn chiefly the elements, vocabularies, nomenclatures, and classifications) ; lastly, to the knowledge of raw materials, of which the school possesses specimens and samples. In this form the pupils begin the study of foreign languages, the foreigners learn French, and the French pupils make a more profound study of the rules of their native idiom. This division of studies clearly shows that the school must have a fixed minimum of age for the pupils admitted ; in fact, the understanding and memory may suffice for certain studies, but to pursue them with profit there must be attention, reflection, and judgment. The minimum age for the admission of pupils was therefore fixed at 15 for the first form, and the school is now rather disposed to fix it later than earlier.

The second year, or second form, does not receive pupils under 16 ; it comprises the continuation of some of the preceding studies, book-keeping, the theory of accounts in all its parts, the application of arithmetic to all the operations of trade and banking, exercises in mental arithmetic, a course of correspondence, and essays intended to accustom pupils to express their thoughts rapidly with precision and perspicacity, linear drawing, geometry, the elements of algebra, commercial geography, the study of the Code of Commerce, the continuation of foreign languages. We have designedly indicated the limit of age for the pupils of the second form, although the rule established for entering the first would seem to render it unnecessary ; it raises new difficulties for us every year, and yet must be maintained. The pupils have very generally a most decided tendency to enter the second form, careless whether they will be able to follow its courses with profit ; to leap over the elementary year is with them, and too often with their parents, a question of ambition rather than of instruction.

We have the utmost difficulty in convincing those who have obtained the bachelor's diploma by dint of cramming and coaching, that the science of trade is not a unique whole, composed of formulas more or less simple, more or less numerous, which have only to be learned and remembered in order to make them at once skilful merchants. They are astonished when told that long and serious study is required to learn what they had considered so easy ; they are desirous, at the very outset, to attack the highest parts of the science, to devote their attention to finance, to great mercantile enterprises and complicated operations in the funds, to attempt as mere play, the difficult and dangerous functions of consular justice. In one word, they want to reverse the natural

course of things, and to begin with what can only be the end of anxious study, the result of positive knowledge and practical acquaintance with real business. It was therefore indispensable to fix a limit of age for admission to the second form, and to introduce an examination for classing according to merit, which all must pass who enter the second form without passing through the first; bachelors of sciences are alone exempt from this measure.

The third year, or third form, is the indispensable complement of the instruction given at the school; it is devoted to the higher branches of learning, and to practical exercises; it includes the study of the exchanges and of arbitration, which has been too long neglected in France, and to which the increasing number and extent of our business relations with foreign countries gives fresh importance and furnishes daily occasions for their use; multifarious applications of accounts to commerce, manufactures, and agriculture; analytical chemistry and chemical manipulations applied to the study of merchandise, and to the discovery of adulterations (thus completing the course of general chemistry followed in the two first years); the continuation of the studies of geometry and linear drawing, the elements of mechanics applied to the requirements of commerce and industry, and to the material of trading ports, railways, and docks; the technology or description of the principal manufactures, mercantile and maritime law, and political economy. In this form all the studies are applied by the simulated exercise of trade, each pupil opens and closes accounts and correspondence of all kinds. The pupils, divided into groups, or commercial firms, renewed from time to time, buy and sell goods, keep banks, charter vessels, assure, commission, correspond, and perform under the guidance of an able and experienced professor, all the most varied and most difficult operations. After Easter, the pupils of the third form, accompanied by a professor of technology, visit the principal factories of Paris and its environs, the custom-house, bonding warehouses, &c.

It was to assist the exercise of this form that the use of fictitious bank notes and money was at one time introduced, but these were promptly abandoned by the school as puerile expedients, proper enough perhaps to be employed for children, like the coloured balls and pictures of infant schools, but altogether useless with young men bent on earnest study, and likely only to distract their attention and cause a loss of time. The same means have many times since been adopted in other schools as a new invention, but they have always been laid aside as useless.

The course of instruction in the school, as well as the allotment of time to the classes and studies, have been regulated as methodically as the multiplicity of subjects allowed. The pupils rise at half-past five all the year round, and at six commence the business of the day. They go to bed at nine o'clock. The hours of every day are employed nearly as follows: five hours lessons, six hours of study, and four hours' recreation, including 40 minutes for breakfast and dinner.

In the three forms, each course is confided to a special professor, with the exception of geometry and linear drawing, which are taught by one person, and of mechanics and technology which are in the same case. Each pupil must attend all the courses of the form to which he belongs. He must learn at least one foreign language, and may learn several if he can find time without neglecting his other studies. The pupils are expected to take notes, as complete as possible, of the lessons given by the professors; to study them in private, to consult the authors placed at their disposal, on the same subjects, and to make a summary of the lesson, a fair copy of which they deliver in the evening to the inspector of the form, who hands it to the professor at the next lesson. Special examiners every day interrogate the pupils of the second and third forms, on the parts of the principal courses, already studied, and an account is kept of the marks merited by their answers.

Every quarter there is a competition for classing the pupils in all the branches of instruction, and immediately after, the director announces the places obtained by all in the presence of the professors and pupils. A statement of the marks merited by each pupils for conduct and application is addressed to the parents. At the end of the school year, a board, composed of members of the council of improvement, and of the professors, awards to the two best pupils of the third form, as a first and second prize of honour, a gold medal and a silver medal, given to the school by his Imperial Highness Prince Napoleon, as a testimonial of the great interest he takes in commercial education. The same judges award to the best pupils of the second and third forms, two silver and four bronze medals, given by the Minister of Agriculture, Commerce, and Public Works. The pupils of the third form who have completed their studies and successfully passed the final examinations before the committee delegated by the Council of Improvement, receive, when the prizes are distributed, a diploma of capacity delivered by the school and signed by the Minister of Agriculture, Commerce, and Public Works, president of the council of improvement. This is the only document the school recognizes as official, and certifying complete studies; no certificates are given for partial studies.

The organization of the management and discipline of the school is as simple as that of the studies; for the last 10 years the school has received neither day-scholars nor half-boarders; all are boarders, and their number never exceeds 100 at the same time, distributed into four dormitories and 20 private chambers, which the pupils enter only when they go to bed; all their waking hours are passed in common, in the amphitheatres, and the class-rooms, under constant supervision.

The discipline, of which we must say a few words, is of course adapted to the age of the pupils (16 to 25 or 26). It is entrusted to the sub-director and four inspectors, three of whom are each charged with a form, while the fourth has certain special duties, and besides acts as substitute for the others in case of need.

The supreme conduct of the discipline lies with the director, who alone can inflict punishment; the professors and inspectors having only the power to warn or reprimand the pupils, and make reports to the director. The minutes of the forms and classes, the reports of the inspectors, with notes by the sub-director, are laid before the director every evening, and give him, with frequent personal visits during all the exercises, a full knowledge of each pupil, whom he is thus able to direct according to his talents and character. This organization would not do for a very large number, and the limit of 100 is therefore never exceeded. The number of pupils who enter in a year is about 110 on the average. The length of time pupils remain is far from being the same for all, owing to the different degrees of proficiency on entering, the diversity of their destinations, and, lastly, to their difference of capacities, which will not allow all to enter on the higher studies with any chance of success. The number of pupils in each form ranges between the extremes of 30 and 50 for the first and second, and of 15 and 25 for the third.

The pupils are all warned on entering that they can only remain in the school on condition of steady application to study. They are given to understand that they come there for a commercial purpose, to purchase the instruction and instruments of their future profession. This notion is incessantly presented to them in every possible form: thus it is proved to them that they expend at the school about five francs per day, and that if each of them is not worth five francs more every night, he will have made a bad speculation, which it will be our duty to put an end to as soon as possible if no improvement should take place. The discipline of the school is not severe, but it is very strictly enforced; there are scarcely any punishments; a pupil may be kept in the half or whole of Sunday, but this must not occur often, the pupils being always warned that persistence in misconduct or neglect of study will render their dismissal inevitable; we may therefore say that the only serious penalty is the expulsion of disobedient or idle pupils. The time which families allow the school for the development of its instruction (barely two years on the average), is too short for any part of it to be lost in struggling against ill-regulated minds and rebellious tempers—a very meritorious work undoubtedly, but quite impracticable with the means we possess and foreign to our object. The dismissal of a pupil, unless for very serious reasons, is not attended with any publicity; it generally takes place at the end of a quarter, when the pupil is sent home with an explanation of the circumstances. There are usually several cases of this kind every year at the end of the first quarter.

The pupils of all the divisions attend public worship under proper supervision, at the churches or chapels of the religious communion in which they have been reared.

I should be afraid of making the account of our system too long were I to enter into all the details of all the courses, and describe what determination, patience, experiments, and efforts have been required to organize them, to bring them all to bear on

one common object—commerce, and to keep them, by a proper choice of professors, on a level with the developments and changes which the discoveries of science have successively effected in the commercial movement of the world. I will, however, take the liberty of citing one or two examples which will render our idea more easily understood.

Does not arithmetic, the science of figures, appear as if it must be, always, everywhere, and for all, the same study? Such is not the fact, however; the astronomer who calculates the interplanetary distances, thinks only of obtaining correct results, regardless of the time devoted to the task; whereas the merchant, obliged to draw up and forward by the day's mail a score of current accounts, is of course equally anxious for accuracy, but must also be expeditious; commercial arithmetic is therefore constantly on the search for abbreviated methods, simple and precise formulæ, and rapid processes. To attain this end, these courses must be entrusted to special professors, endowed with peculiar aptitudes, and constantly occupied, from a natural taste, with this kind of research. Now everybody knows how difficult it is to find such men, at the same time combining all the necessary qualities of a professor.

Commercial geography presents a no less interesting object of study as regards the modifications it has undergone through the extension of railways and steam navigation; geography, as observed by the Minister of Public Instruction in one of his circulars, can no longer be regarded as an arid nomenclature of places, rivers, &c. I will add that it has every day a higher object, a more social mission—that of studying and indicating the shortest and best means of communication between producing and consuming countries, and of facilitating the diffusion of knowledge and the development of progress. Thus, according to an ingenious suggestion made by M. Natalis Rondot, a member of our Council of Improvement, the base and elements of an excellent course of commercial geography might be found in a collection of the itineraries of the Messageries Impériales and other great steam navigation companies of France and foreign countries.

These few words will suffice to show how far I was right in saying that in commercial education it is indispensable to bring all the sciences into close connexion with the idea of trade, and how great the difficulty of finding professors properly prepared. It does not suffice, in fact, for them to be thoroughly instructed, they must also for certain sciences (account keeping, for instance), be practical men, who have been engaged in actual business as bankers, merchants, and manufacturers, and have had to encounter the difficulties constantly occurring in such careers and requiring immediate solutions. Here we see the most serious difficulty in the way of carrying out commercial education on a large scale; it lies in the very limited number of these special men, so rarely to be found—enlightened and zealous men, of whom the Superior School of Commerce well knows the value, to whom it is proud to own that a great part of its success is to be ascribed. To increase their number by opening to them a new career it will be

necessary to assure them a future which is at present attainable only for a very few,—a future of sufficient promise to attract them, and duly proportioned to the importance, the merit, and the fatigue of their labours.

We have been so absorbed by the description of the plan of the studies and of the internal organization of the Superior School of Commerce that we have omitted saying anything about its history, which now extends over nearly half a century. We must not, however, neglect a brief statement of its annals, which contain much useful instruction and fully confirm the excellence of the principles on which the school was founded.

The beginning was auspicious: pupils came in numbers, and, we may add without exaggeration, from all parts of the world. The proportion between the number of French and foreign pupils is the same now as at first, being one third for the latter and two thirds for the former. The well-selected staff, noted both for learning and zeal was able to follow the plans laid down by the founders, and before two years were past the future of the school seemed to be assured. But disappointments soon came; the expenses of the school were heavy—much too heavy for the capital invested in the enterprise; continued success might have rendered the money sufficient, but it dwindled away and gradually disappeared in presence of protracted difficulties, rendered still worse by political events. The staff soon experienced losses, which could not be repaired under existing circumstances; blunders were committed by the managers, and the state of affairs became daily more embarrassed; the school changed hands several times, and at last failed entirely soon after the revolution of 1830.

In this crisis, Adolphe Blanqui, professor of the history of commerce and of political economy in the school, ventured to undertake, on his personal account, a scheme which till then had been disastrous to its conductors, and to assume the whole responsibility on himself. He was young, without fortune, had already a family to support, the times were hard, and the future gloomy; he had to accept a heritage of ruins and to stem the tide of public opinion, which was then in favour of what has long been called protection of the national industry. Nothing could deter him; he was determined to save from destruction an institution which could develop the ideas of political economy and commercial liberty to which he had already vowed his existence. He brought to its aid his indefatigable activity, his inexhaustible and charming intellect, his great learning, the numerous and useful connexions attracted by the engaging amenity of his character; he contrived to restrict the school within limits more in harmony with the resources at his disposal and the perils of the moment. Followed by the pupils who admired and loved him, surrounded by a small group of professors faithful to the work, he set all an example of industry and devotedness, he laboured without ceasing and shrunk from no obstacle. Indeed, when we contemplate this struggle, which lasted five and twenty years, and only ceased with his death, we do not know which most to admire, his courage, his activity, the variety of his acquirements, the

fecundity of his resources, or the irresistible influence which he exercised over all who came near him.

From this epoch, the history of the school is the biography of Blanqui ; his personality overshadowed and protected it at the same time. Deputy for Bordeaux, a member of the Institute, a brilliant writer and applauded professor, he shed over the school the lustre of his rising fame, and gave it a world-wide reputation by his books ; he drew down on it the kindly notice of the Government, whose co-operation he secured.

About 1838, M. Cunin-Gridaine, then Minister of Commerce, struck with the great services rendered by the school, and taking a deep interest in the proceedings of its forms, (at the final examination of which he one day condescended to preside,) conceived the design of giving the benefit of its instruction to a certain number of young men whose limited means would not allow them to enter. He granted several subventions in the form of half-scholarships ; subsequently, it was found that this measure was inadequate, and that the sums remaining to be paid by the pupils' parents were still beyond the means of the persons whom it was intended to benefit. By a ministerial decision, dated 8th June 1853, M. Magne transformed these half-scholarships into a proportional number of whole ones, and, at the instance of the present director, who had taken part in Blanqui's labours, it was decided that these scholarships should be the object of competition in the principal commercial towns, one-third of them being conferred every year. This plan has now been followed for 11 years, with the most satisfactory results. Owing to the careful supervision of these competitions by the Government, the pupils enter the school with a good preparatory education, and we have observed with pleasure that the best of them have always come from the superior primary schools. They soon attain good rank in our forms, where they have become an element of emulation, and three times, in these 11 years, these scholarship pupils have obtained the gold medal, the prize of honour at the school. It was one of these pupils from Bordeaux who obtained it last August, and every year these scholars have had a fair share of the other prizes.

Blanqui, in his long career, had become fully convinced of the soundness and wisdom of the principles of the constitution of the school, he therefore always respected it ; even when compelled, by the difficulties of the day, to submit to certain modifications, he always recurred to the original arrangements at the earliest possible moment. The consequence was that when, after a quarter of a century's persevering and courageous struggle, he died prematurely in 1854, exhausted by his efforts, overwhelmed, but unshaken in his confidence, by the burden which events had accumulated on him, the school, which had really become his own work by all he had done for it, passed into inexperienced hands without any serious detriment. The present directors, coming to the work like labourers of the later hours, after the great heats and hardest toils of the day, have only had the easy merit of believing in the soundness of an undertaking which had outlived

so many storms, and of bringing to its aid the resources which had always been wanting, and the habits of industrial and commercial administration, the application of which was facilitated by the possession of them. Their grand object has been to maintain the traditions they have learned during too brief connexion with Blanqui, to keep the teaching staff of the school complete and adequate to its mission, and to take good care that, while preserving entire the form and spirit of the teaching at the school, the instruction given shall keep pace with the incessant progress of science, and the forward movement which is daily imparted to commerce and industry.

They have been led by 11 years' experience, to the conviction, that it is impossible to conduct the education and training of young men from 16 to 25 years of age without constant personal supervision; that it is equally impossible in a great city like Paris, with young men of that age, belonging nearly all to families in at least easy circumstances, to act usefully, in the double point of view of instruction and moral training, on out-door pupils; they have therefore determined to admit none, though they might be an important aid as regards the financial results. They have no confidence, as a general rule, in the efficiency of isolated study in separate rooms, and it has therefore been suppressed altogether.

The school, after weathering the storms which assailed it, has now followed its normal course for 11 years, and has always had its full complement of pupils, notwithstanding the fluctuations in the number of foreigners which have always been caused by political events, but these have never been large enough to seriously affect the revenues of the establishment.

The Superior School of Commerce was founded on an idea, the practical truth of which was long disputed; in the 45 years of its existence, it has passed through three quite distinct periods.

Through these three varied and distinct phrases, with all the obstacles which arose in them, the school has constantly advanced towards the end in view. It has realized its object, has scattered over all parts of the world, through all classes of society, in all the branches of public and private administrations, of trade and banking, numerous pupils, of whom it has unfortunately failed to keep a proper record, but whom it is now endeavouring to trace out.*

And now that the ideas on which the school was founded and for which it has struggled so hard,—the ideas whose possible application has been so long disputed,—have at last obtained justice; now that commercial education is accepted as possible and necessary, that every educational establishment great or small,

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* It would be already possible to cite in Paris alone, in the public administration, an ex-minister of finance, a director of movement of funds, an inspector-general of the Government breeding-studs, also chiefs of divisions and head clerks, in divers Government offices. In private life, bankers, both French and foreign; stock-brokers, merchants, directors of railways, insurance companies, accountants, clerks of all ranks, &c.

must have its professional instruction, its commercial classes, what will be, as regards the prosperity of the Superior School of Commerce, the consequences of this unanimous concert, of this multiplication of attempts? Whatever they may be, the school is prepared to meet them. We will labour with redoubled energy, we will strive to walk in the steps of our predecessor. We will not forget that the Superior School of Commerce has ever had for its mission to complete the education of those who wish to be ready for the great commercial struggles opened during the last twenty years by the discoveries of science. Competition is one of the conditions of liberty; we hail it with pleasure, and shall be sufficiently rewarded if we succeed in proving, by our example, that the ideas of liberty, when well understood and courageously applied, are always productive of good.

GERVAIS (de Caen),
Director of the Upper Commercial School.

STATEMENT OF THE VARIOUS TECHNICAL SCHOOLS IN EACH DEPARTMENT OF FRANCE.*

AIN.—The farm schools of *La Saulsaie* and *Pont-de-Veyle.*

AISNE.—*St. Quentin.*—Course of industrial drawing for adults of all trades; 60 pupils. The Imperial Free Drawing school; 60 to 70 pupils.

ALLIER.—Two preparatory technical schools at *Moulins*, with about 100 pupils, and an agricultural school at *Belleau.*

ALPS (UPPER, LOWER, and MARITIME).—One farm-school in each of these departments.

ARDENNES. — *Charleville.* — A professional school with 300 pupils, already noticed in a special report.

ARIÉGE.—A farm-school at *Royat.*

AUBE.—*Troyes.*—Municipal school of drawing and architecture with 114 pupils. A gratuitous course of German and English, with from 15 to 20 pupils. A sewing-school for girls has 18 boarders and 30 day-pupils.

AUDE.—A farm-school at *Besplas*, with 24 pupils.

AVEYRON.—A chair of agriculture at Rodez.

BOUCHES-DU-RHÔNE.—*Aix.*—Imperial school of arts and trades (see Special Report), and a private preparatory technical school, with 155 pupils.

Marseilles.—Preparatory school of Arts and Trades, with 70 pupils.

La Ciotat. See special report.

Farm-school at *Montaurone*, with 36 pupils.

Schools of Hydrography at *Marseilles, La Ciotat, Arles*, and *Martigues.*

CALVADOS.—*Caen.*—Three public and gratuitous courses for drawing, scripture, &c., with 112 pupils. Course of agriculture, with 50 pupils; of horticulture, with 20 pupils; and of agricultural chemistry, with 75 pupils. A sewing-school for girls and four

* Communicated by the Prefects of the Departments.

orphanages, wherein children of both sexes receive primary instruction and are taught some industrial art.

Bayeux.—Two schools in which girls are taught sewing, knitting, and embroidery.

Lisieux.—Drawing school for working men ; 20 pupils.

Vire.—Public course at the Hôtel-de-Ville, for improving the elementary instruction of the working class, and imparting the scientific knowledge most useful for the local industries. There are about 70 pupils on the average.

Condé-sur-Noireau.—Professional courses for the instruction of the foremen and workmen employed in spinning, weaving, and other local industries ; 42 pupils.

CANTAL.—*Aurillac.*—Trade school for drawing, mathematics, sculpture, &c. ; 30 pupils.

Murat.—Lace-making school ; 85 pupils. At this place, and at *Mauriac* and *St. Flour*, there are also sewing-schools, with 25, 40, and 50 pupils respectively. At *St. Paul-des-Landes* a farm-school, with 33 pupils.

CHARENTE.—*Angoulême.*—Public and gratuitous courses of applied physics and chemistry, with an average attendance of 100, and a course for drawing, with 62.

Bardines.—A course of horticulture, attended by about 80 persons.

CHARENTE (LOWER).—*La Rochelle.*—Evening school for drawing and geometry applied to the industrial arts ; 150 pupils. Farm-school at *Puilboreau.*

CHER.—Farm-school at *Laumoy.*

CORRÈZE.—*Tulle.*—Departmental trade school for young workmen ; 100 pupils. The schools at the Imperial Manufactory of Arms have been described in a special report. There is also at *Les Plaines* a farm-school, with 45 pupils.

CÔTES-DU-NORD.—Farm-school of *Castellaouënan*, with 33 pupils.

At *St. Brieuc* a school for lace-making, with 30 to 40 pupils and at *Tréguier* one for sewing and embroidery, with 25 pupils.

CREUSE.—The farm-school of *La Villeneuve.*

DORDOGNE.—The farm-school of *Lavallade.*

DOUBS.—*Besançon.*—Municipal school for teaching the theory and practice of clock and watch-making, established by the municipality in 1862. The course occupies three years, and the number of pupils is 30.

There are also at Besançon gratuitous courses on the application of mathematics to arts and manufactures, with 12 to 15 pupils, and a drawing school, with an average attendance of 150 pupils. A chair of agriculture has also been founded there.

EURE-ET-LOIRE.—In this department there are 11 sewing-schools established by charitable persons at *Chartres*, *Illiers*, *St. Luperce*, *Dreux*, and *Nogent-le-Rotrou.*

FINISTÈRE.—A farm-school at *Trévarez*, a practical school of irrigation and drawing at *Lézardau*, and a chair of agriculture at *Quimper.*

GARD.—*Alais.*—School for educating overseers and foremen of

mines, founded by the Government in 1843; it is supported by the town of Alais and the department of the Gard, with a subvention from the State. The number of pupils, all boarders, is 28. The results are very satisfactory.

Nimes.—Weaving school, theoretical and practical, with a course of pattern-drawing, founded by the municipal council in 1856 at the expense of the town. It is regularly attended by 30 pupils, with most satisfactory results.

Nimes has also an excellent school of design likewise founded by the municipal council. It comprises four courses:—1. A course of artistic drawing, including the figure, the round, landscape, and painting. 2. A course of ornamental drawing, with modelling and sculpture. 3. A course of linear drawing, including plans, designs of machines, &c. These courses are diligently followed by 145 pupils. To these three the municipality has added; 4. An evening course for adults, in which workmen are taught drawing applied to carpenters' work, stonecutting, &c.

The municipal council has founded, in addition to the above, a course of chemistry and physics applied to the industrial arts, especially to dyeing.

GARONNE (UPPER).—*Toulouse.*—School of the fine arts and industrial sciences. In this establishment there are courses of drawing in all its branches, of painting, sculpture, architecture, anatomy, arithmetic, geometry, physics, and chemistry, of algebra, descriptive geometry, perspective, and stereotomy. The number of pupils was about 600 in 1863.

There are also a commercial school (private), with 120 pupils, courses of agriculture, of arboriculture, and an imperial veterinary school.

GIRONDE.—*Bordeaux.*—Evening classes for adults founded and conducted by the Philomathical Society. There are in all 21 classes attended by 1,810 pupils. The subjects taught in addition to reading, writing, and arithmetic are, geography, geometry, (plane, solid, and descriptive), algebra, mechanics (with application to steam-engines), practical hydraulics, drawing, physics, chemistry. The same society has also opened classes for apprentices.

Municipal professional course of mathematics and their applications; 130 pupils.

A naval school supported by the department, the city of Bordeaux, and the Chamber of Commerce. There are from 150 to 200 pupils, who are taught on board the frigate *La Brillante*, moored in the Garonne. Lastly, a chair of agriculture.

HÉRAULT.—*Montpellier.*—A private commercial and technical school in which pupils are prepared for the Imperial School of Arts and Trades at Aix.

ILLE-ET-VILAINE.—In this department there are courses of book-keeping and drawing annexed to the college at *Dol;* agricultural schools at *St. Jouan-des-Guerets* and *St. Mëen;* and eight sewing schools at *St. Malo, St. Servan,* and *Fougères.*

INDRE.—Farm-school of *Villechaise,* and a reformatory at *Fontgombault,* kept by the Trappists, who give instruction in agriculture and the trades dependent thereon.

INDRE-ET-LOIRE.—*Tours.*—Courses of drawing, with 180 to 200 pupils; of horticulture, with 150 to 200 pupils; of chemistry and physics, with about 200 pupils.

Farm-school at *Chedigny*, with 33 pupils.

LANDES.—Farm-school at *St. Sever.*

LOIRE-ET-CHER.—*Ménars* and *Blois.*—Professional schools for preparing pupils to enter the schools of arts and trades, &c. There are also 16 sewing schools at *Blois, Ménars, St. Aignan, Meusnes, Vendôme, Romorantin,* and *Salbris.*

Farm-school of *La Charmoise.*

LOIRE.—*St. Etienne.*—School of miners, founded by Government in 1816, to train mining overseers and foremen; 54 pupils.

The municipality has founded a public course of chemistry applied to the industrial arts, and a drawing school chiefly directed to forming pattern-designers for ribbons.

Roanne.—Drawing-school for workmen.

Agricultural school at *La Corée.*

LOIRE (UPPER).—*Le Puy.*—Industrial evening schools, founded by the town, for the instruction of workmen in drawing and mathematics applied to industry. There is also an industrial course annexed to the Imperial Lycée.

LOIRE (LOWER).—*Nantes.*—The schools of the Industrial Society and the *Upper Trade* School are described in special reports.

Imperial agricultural school at *Grandjouan*; farm-school at *St. Gildas.*

LOIRET.—*Orléans.*—Upper Trade School, with 90 pupils.

Four sewing-schools.

LOT.—Farm-school at *Le Montat* for 36 pupils.

LOZÈRE.—*Mende.*—Lace-making school, with 17 pupils.

Farm-school of *Recoulettes*; 32 pupils.

In this department there are also five schools for embroidery, and two orphanages, one for boys, the other girls.

MAINE-ET-LOIRE.—*Angers.*—Imperial School of Arts and Trades (see special report).

Municipal drawing classes, with 50 pupils.

MANCHE.—*St. Lô.*—Course of drawing, theoretical and practical, founded by the municipality for the benefit of the working class; 50 pupils. There is also a course on gardening and fruit-trees.

St. Waast-la-Hougue.—School of hydrography.

Sewing-schools at *Coutances* and *Carentan.*

MARNE.—*Châlons.*—Imperial School of Arts and Trades (see report).

Reims.—Industrial School founded by the Industrial Society of Reims, with 80 pupils, and annexed to it three public gratuitous courses on commercial law, drawing, and manufactures; 70 to 80 pupils.

Public courses of physics, chemistry, and drawing; 250 pupils.

Sewing-schools at *Epernay, Montmirail,* and *Sézanne.*

MAYENNE.—Farm-school of *Le Camp.*

MORBIHAN.—Farm-school of *Trécesson*; 30 pupils.

MOSELLE.—*Metz.*—Superior industrial school, founded by the town; 235 pupils.

Private trade school at *Longwy.*

NIÈVRE.—*Nevers.*—School of art, founded by the town; 45 pupils.

Farm-school at *Poussery.*

NORD.—*Lille.*—School of the industrial arts and of mines. Its object is to give technical instruction, on the principal industries of the Nord, to young men who have already received a good general education. Its present organization dates only from 1861, when it was placed under the direction of the Minister of Commerce. Its only revenue consists of the payments of the pupils with a subvention of 7,000 francs, from the department. It had only 30 pupils at first. As soon as the resources of the establishment will permit evening classes are to be opened for adults.

Class for stokers, founded by the Lille Society of Sciences, and supported by the voluntary subscriptions of manufacturers and others using steam engines; 15 to 20 pupils.

Academic schools, founded and supported by the city. The courses of painting, sculpture, figure-drawing, perspective and anatomy applied to design, are attended by 250 pupils; those of architecture and ornament by 50; those of applied geometry, mechanics, geometrical and linear drawing by 250; in all 550 pupils. The results are very satisfactory.

There is also at Lille a superior primary school for the sons of artisans; it has 180 pupils.

Tourcoing.—Courses of physics and chemistry founded by the town; 20 to 40 pupils.

Weaving school for orphans; 14 pupils.

Roubaix.—School of drawing applied to manufactures; 14 pupils.

Course of physics and chemistry adapted to the local industries; 130 pupils.

Douai.—Academic schools for drawing, &c.; 130 pupils, many of them adults.

Valenciennes.—Academic schools, for painting, sculpture, and architecture, the pupils respectively numbering 60, 67, and 40; in all 167. The expenses are borne by the town.

Cambrai.—A trade school (private) for commerce, manufactures, and agriculture; 186 pupils. There is also another school of the same kind managed by the Christian Brothers, with 90 pupils.

Bailleul.—Lace-making schools, with 800 pupils, and sewing schools with about 600.

Lille.—Three sewing schools, with about 240 pupils.

Loos.—Sewing school with elementary education; 90 to 100 pupils.

OISE.—Farm schools at *Mesnil-St.-Firmin*, and at *Beauvais.*

ORNE.—*Alençon.*—Public courses of drawing, arithmetic, and geometry, for workmen; 50 pupils in winter, 25 to 30 in summer.

Farm school at *St. Gauthier.*

PUY-DE-DÔME.—*Clermont.*—Communal trade school supported by the town; 250 pupils.

Volvic.—School of architecture; 20 pupils.

PYRENEES (LOWER).—Farm school of *Talon.*

PYRENEES (UPPER).—Farm school at *Virens*, near Lourdes; 30 pupils.

Tarbes.—Municipal trade school, with 80 pupils.

PYRENEES (EASTERN). — Farm school of *Germainville;* 33 pupils.

RHINE (LOWER). — *Graffenstaden*, near Strasburg. Trade school (see special report).

RHINE (UPPER).—*Mulhouse.*—Trade school.—Under this title have been combind three special schools, having the same staff of professors and premises common to them all. They are—

1. The Free Secondary School, with very nearly the same curriculum as the imperial lycées, but with the addition of four elementary classes for boys between the ages of 7 and 12.

2. The Industrial School for boys from 14 to 18 years of age, who in addition to scientific and literary instruction, are taught theoretically and practically the construction of machines, or mechanical weaving and spinning, or the chemical arts connected with the dyeing and printing of tissues.

3. The Chemical Laboratory, the courses of which occupy two years.

This school has in all its departments a total of 312 pupils.*

A theoretical and practical school of weaving by machinery has been established at Mulhouse under the auspices of the Industrial Society of the town. It is supported by voluntary subscriptions, and managed by a committee of seven members selected from among the principal resident manufacturers. There are at present 36 pupils of the 1st year, the same nnmber of the 2nd, and 42 of the 3rd, which is the greatest number that can be accommodated. The charge for admission to both the theoretical and practical courses is 600 francs a year; to the theoretical only, 300 francs; and to the practical only, 400 francs. There are also evening courses for workmen at 25 francs per month, but this charge is reduced almost to nothing for deserving workmen.

Mulhouse has also a drawing school, founded by the Industrial Society, chiefly intended to form pattern designers. There are 70 pupils, many of whom are admitted gratis, the others pay 4 francs per month.

There is, besides, a trade school for youth of the Jewish community. It has at present 47 pupils. They are admitted from 14 to 16 years of age, and remain three years in the establishment.

Mulhouse has excellent municipal schools for both sexes. The boys' school is divided into three: the elementary school (four years), the middle school (three years), the higher school (two

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*. See Vol. I. p. 243.

years). The number of boys in all of them amounts to about 1,800. The school fee is 20 to 30 francs a year, but many are admitted gratuitously.

The municipal school for girls is attended by about 1,200 pupils. They receive a good general education, and are taught sewing, embroidery, and other occupations proper for their sex.

Lastly, Mulhouse has a superior school of sciences and letters, constituted by imperial decree in 1855, under the authority of the Minister of Public Instruction, and supported by the town. Its special object is to teach the applied sciences, mechanics, descriptive geometry, physics, chemistry, drawing, &c. There are also lectures on the literature and history of France. Certificates of capacity for the applied sciences are granted to deserving pupils. The number of pupils inscribed is at present 30, but more than 200 persons often attend the lectures.

Guebwiller.—Popular library and evening school founded in 1858 ; 500 pupils, chiefly of the working class.

There are also at Guebwiller evening schools for girls and women employed in factories during the day ; 145 pupils.

St. Marie-aux-Mines.—Upper trade school, founded in 1863, to prepare youth for industrial and commercial occupations. Fee, 5 francs per month. Four hours instruction daily, from 8 to 10 in the morning, and 2 to 4 in the afternoon. The number of pupils at present (1864) is 17 only.

There are also in this town gratuitous technical evening classes for adults, attended by about 130 pupils.

RHONE.—*Lyons.*—The gratuitous professional school of *La Martinière*, so called from its founder, Major-General Claude Martin, a native of Lyons, who died at Lucknow in 1800, in the service of the King of Oude. 500 pupils, all belonging to the artisan class, are here educated during the day, and 200 adults attend classes in the evening.

The Central School for industry and commerce was founded in 1857 by an association of merchants and manufacturers, and placed under the direction of M. Girardon, professor at La Martinière, and at the Imperial School of Fine Arts. The number of pupils is at present 80, all out-door. The school hours are from 7 till noon, and from 2 till 6 in the evening. The pupils are admitted at 15 years of age, after an examination.

The course of instruction, which extends over three years, comprises arithmetic, algebra, elementary geometry, trigonometry, descriptive geometry, analytical geometry, the elements of the differential and integral calculus, industrial physics, chemistry, (organic, inorganic, and analytical), mechanics, construction of machines, metallurgy, resistance of materials, geology, mineralogy, natural history, book-keeping, English language, drawing of machines, &c. There are also workshops for practice in the manual arts. The instruction is given in the form of lectures, the pupils being permitted to make objections and ask explanations. After the three year's study they undergo general examinations, and if deserving, obtain diplomas.

The School of Fine Arts, especially intended to give such instruction as may be useful to the local industries.

Course of instruction for stokers.—Two lessons weekly, generally attended by about 50 pupils.

Theoretical course of instruction for silk workers.—80 pupils.

Course of chemistry applied to dyeing, founded in 1860 ; 70 pupils.

Course of artistic design for adults, founded in 1853. There are on the average 250 to 300 pupils in the year ; the lessons are given three evenings per week, from 6 to 8 o'clock.

Course of linear drawing, applied to various trades, for adults. Founded in 1849. Three lessons per week of two hours each. 200 pupils in the year.

Course of horticulture and agriculture, founded in 1858. About 60 pupils yearly.

Practical School of Horticulture, at *Ecully*, near Lyons. The lessons are given on Sundays, and are attended by 300 persons on the average.

Course of commercial book-keeping for females, founded in 1857. The studies occupy two years, and the average of pupils is 75. The more deserving receive diplomas on leaving.

Course of artistic and industrial drawing for females, founded in 1856 by the Primary Instruction Society. The annual number of pupils is about 75 ; three lessons per week of two hours each.

Adult classes for males, founded by the above-named society ; 110 pupils.

Tarare.—Professional courses. Drawing applied to patterns of tissues and embroidery, physics, and mechanics ; 80 to 100 pupils.

SAÔNE-ET-LOIRE.—*La Creusot.*—Industrial schools for both sexes. Attendance 7 hours a day. Number of pupils : boys, 900 ; girls, 700. There are also evening classes for adults, and a lace-making school with above 200 pupils.

Farm school at *Le Montceau.*

UPPER SAÔNE.—*St. Remy.*—Industrial school, with 75 pupils.

Farm school at the same place.

SARTHE.—*Le Mans.*—Course of industrial and ornamental drawing ; 100 pupils ; three lessons weekly in the evening. Sewing school for girls, with 30 pupils.

La Flèche.—Trade school (private) with 58 pupils.

Farm school at *La Chauvinière.*

SAVOY (UPPER.) — *Sallanches.* — Clock and watch-making school, founded and supported by the town, aided by a subvention 1,200 francs a year given by the Emperor ; 10 pupils. There are two other schools of the same kind at *Cluses* and *Thônes*, the former with 15 to 25, the latter with only 4 pupils.

SEINE.—The *College Chaptal* and the *Ecole Turgot* have been made the subjects of special notices.

The municipality of Paris has established seven industrial drawing schools in different parts of the town, some of which are very successful.

SEINE-ET-MARNE.—A private school, with workshops for the practice of manual labour at *Lagny.*

SEINE-ET-OISE. —*Versailles.* — Public courses of geometry, drawing, &c., supported by the town.

SEINE (LOWER).—*Rouen.*—Professional courses, founded by the town. The studies occupy three years; 90 pupils. There are similar courses at *Le Hâvre* and *Montvilliers*, with 30 and 60 pupils respectively.

SÈVRES (TWO).—*Parthenay.*—Course of agriculture, dependent on the primary normal school, chiefly intended for the pupil-teachers, to whom the lectures are given on Thursdays. The public day is Wednesday.

SOMME.—*Amiens.*—Public courses, founded by the Industrial Society.*

Chemistry applied to dyeing; 100 pupils.

Mechanics; 100 pupils.

English language; 60 pupils.

German language; 20 pupils.

TARN.—*Castres.*—Trade school, founded and supported by the municipality to give the instruction required for the local industries. It contains 39 pupils of the 1st year; 37 of the 2nd 28 of the 3rd; 7 of the 4th; and 6 of the 5th; in all, 117 pupils.

TARN-ET-GARONNE. — *Montauban.*— Course of mathematics, geometry and mechanics applied to arts and trades. This course, which is public and gratuitous, was founded in 1828 under the auspices of M. Ch. Dupin. It is supported by the town. 50 pupils on the average.

Course of drawing, linear, graphic, and from the round, founded and maintained by the town; 60 pupils.

There is also a course of arboriculture and horticulture, with 30 pupils.

VAR.—Farm school of *Salgues;* 33 pupils.

VAUCLUSE.—*Avignon.*—Public and gratuitous courses of drawing, chemistry, physics, and mathematics, founded by the town for the benefit of working-men.

Farm school at *St. Privat.*

VIENNE.—Farm-school of *Monts.*

VIENNE (UPPER).—*Limoges.*—The Haute-Vienne Society of Agriculture, Science, and Art has here founded—1. A drawing-school for boys; 100 pupils. 2. A drawing-school for girls; 50 pupils. 3. Modelling school for boys; 30 pupils. 4. School of painting on porcelain for girls; 15 pupils. 5. School of geometry; 60 pupils.

Farm-school at *Chavaignac.*

VOSGES.—Earm school at *Lahayevaux.*

YONNE.—Drawing-schools for adults at *Auxerre, Joigny, Sens,* and *Villeneuve-sur-Yonne.*

Farm-school at *Orme-du-Pont.*

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* See Evidence of Messrs. De Marsilly and Ferguson.

SUMMARY OF THE INQUIRY ON PROFESSIONAL EDUCATION.*

Various as are the questions raised by the inquiry the results of which are recorded in the preceding documents, and diverse as the opinions expressed by the persons heard, or in the reports addressed to the Minister of Agriculture, Commerce, and Public Works, it does not appear to us impossible to give a tolerably concise summary of the principal consequences arising therefrom, and above all to place in relief the more important questions which may be submitted to the Commission for discussion.

General education.

In the first place, and almost with one accord, all the persons consulted have recognized and insisted on the necessity of a degree of general preparatory instruction proportioned to the extent of professional or industrial education which is to be its complement, and which is intended to place every individual in a position to follow with success the career he may have in view, or has already embraced. But at the same time it has been as positively declared by the most eminent principals of industrial establishments, that the deplorable and far too general absence of primary instruction among even the most intelligent workmen was one of the greatest and most lamentable obstacles to the development of their faculties, and the progress of industry.

The insufficiency of the law respecting children employed in factories, as well as of that relative to apprenticeship, and above all, the irregular manner in which they are observed, tending to keep the children as ignorant as their parents, have led the same persons to express an earnest wish that effective measures might be taken by the Government not only to secure the development of primary instruction everywhere, and especially in manufacturing districts, but also to preserve children and apprentices from the abuses which have been denounced.

The inquiry has also taken cognizance of those establishments which give a general literary education, graduated according to requirements, but without professional or technical applications, and has elicited the direct relations which exist between them and the organization of public instruction in the empire. For this part of instruction, as well as for primary, the Commission could not do otherwise than earnestly recommend the Ministry on which they depend to promote their development on the largest possible scale.

The information obtained by the inquiry as to the direction given to the studies in the Chaptal College and the Turgot School, has shown that these establishments correspond, the

* This is a summary of the evidence given before the commission and all the documents which were submitted to it, and was drawn up by a sub-commission consisting of General Morin, Messrs. Julien, Perdonnet, Denière, and Gervais.

former to what the Ministry of Public Instruction designates under the name of "special instruction," and the latter to "superior primary instruction," one of them, the Chaptal College, receiving the sons of merchants or manufacturers, the other those of retailers and petty tradesmen. Both give a general education appropriate to the future position of the children they receive, but without the addition of any technical details whatever. Consequently, though we duly appreciate the services they render to industry, we do not think they belong to the class of establishments over which the Ministry of Agriculture, Commerce, and Public Works ought to extend its action.

Apprenticeship.

Apprenticeship and its connection with education have been the object of many investigations and questions raised during the inquiry, and the three principal solutions of which they admit have been discussed by a large number of persons.

These were generally of opinion that the workshop alone can attain the object of all apprenticeship, properly so called, namely, training the artisan and giving him the requisite manual dexterity. To combine with a real apprenticeship to the future trade the degree of instruction that all workmen ought to possess, two principal means have been successfully employed, and important information relating thereto has been communicated to the Commission. One consists in placing the school *in the workshop* or factory, and in compelling, either by law or internal regulations, the apprentices to attend it daily for a certain number of hours. By this means their primary instruction is improved, and completed by the addition of drawing and of knowledge specially required for their trade. Of this kind are the important factory schools at Mulhouse, Graffenstaden, Wesserling, Le Creusot, La Ciotat, Gamaches, Creil, &c., which have all been founded by the generous and intelligent efforts of the masters, and contribute not only to the instruction of youth, but likewise to attach the population to the industry which gives them education and a comfortable livelihood.

The second solution is that which has been organized by certain municipalities and private firms, but more particularly by societies of patronage, and by men devoted to the moral and intellectual improvement of youth. To choose respectable masters for apprentices, to became a party to the contract of apprenticeship, to see that its terms are duly observed, to visit the apprentice, to send him to school, or receive him at night in an establishment where he is lodged, boarded, watched over, and taught,—such are the steps taken by certain patronage societies. For example, at Arras in the Abbé Halluin's school, which has not less than 250 apprentices, and by the Christian Brothers, under the auspices of the Count de Melun, ever since 1842, at Paris, where there exist as many as twenty societies of this kind, with 3,000 apprentices, and in other towns of France, where there are about a score of similar societies. The same plans are carried out by several Protestant associations, and by the Jewish societies for the encouragement of labour, at Colmar, Strasburg, &c. The beneficial results to be obtained by this second mode of superintending apprentice-

ship have been fully substantiated by many interesting facts put in evidence before the Commission.

A third manner of preparing youth for the practice of different trades consists in establishing a workshop in the school itself, and dividing the pupils' time between study and manual labour. This plan may be applied in several ways; but in all, to diminish the expense as much as possible, the work done by the apprentices ought to be a source of income. In most cases the workshops are devoted to special industries, sometimes to one trade only, as weaving in those of West Flanders, sewing and embroidery in the department of Calvados, clock-making or straw-plaiting in the Grand Duchy of Baden, &c. In other instances the workshops are more numerous and devoted to several trades, as in the Christian Brothers' school of St. Nicholas at Paris, where each workshop is managed by a master who contracts for the work. The evidence given during the inquiry clearly shows that, in this mode of proceeding, the intervention of the masters has the effect of accustoming the apprentice to work with the despatch required in actual business, and of enabling him, as early as the fourth year, to earn a comparatively high salary.

Besides these means of bringing the school and the workshop into intimate connection, there is another which, without absolutely neglecting to turn the pupils' labour to profitable use, aims less at giving them great practical skill in manual labour than at teaching them the best mode of doing their work, and the principles which ought to preside over its execution. The trade schools of Lille and Charleville incline towards this system, though, correctly speaking, manual labour is therein really regarded as a mere exercise, or as a preparation for the schools of Arts and Trades. At the trade school of Mulhouse and that of La Martinière at Lyons, with a few others of the same kind, the work in the shop is not sufficient to be regarded even as a commencement of apprenticeship.

But the best characterized type of the organization of the workshop in a school is presented by the Imperial Schools of Arts and Trades, in which, for three years, young men entering from fifteen to seventeen years of age daily employ five hours in theoretical studies, and seven hours in the workshop, in forging, casting, joiner's work, and fitting. The evidence given during the inquiry has shown that though the pupils of these schools may not, on leaving, have acquired any great readiness of hand or the habit of rapid practical execution, they are nearly all excellent draughtsmen, possess a fundamental knowledge of applied mechanics and the principles which ought to guide them in the execution of their work, and that after a little practice in large establishments, they can soon obtain advantageous positions and become excellent foremen. The explicit statements of M. Houel, engineer in the establishment of J. F. Cail & Co., as well as those of M. Gouin, have also called attention to the great services which the schools of Arts and Trades have rendered to the manufacture of machines, which, without their aid, would not, they assert, have been able to meet foreign competition. It has been remarked

that the three schools of this kind which exist in France being almost exclusively devoted to the making of machines, it might be of advantage to found similar ones for other manufactures.

The School for Miners, at Saint Etienne, gives the theoretical and practical instruction required for mining foremen and overlookers; but though its curriculum be thus limited, many of its pupils have subsequently become eminent engineers. However, this establishment cannot be regarded as an apprentice school, but rather as one giving technical instruction for the training of foremen. The case is altogether different with the school of Alais, which does really train workmen engaged in mining, at the same time giving them the necessary instruction.

Some institutions of the same kind, but exclusively intended for particular trades, and almost completely distinct from the school, have been described in most important evidence. The schools of weaving and spinning at Mulhouse, both quite independent of the trade school in the same town, and founded by the generous efforts of a few manufacturers; the weaving school at Amiens, established by the Industrial Society, that of Rouen, aided by the Prince Imperial's Society, also present examples to which the attention of the Commission has been earnestly directed. Similar establishments which have long existed in several German towns, as at Elberfeld, Crefeld, Berlin, Stuttgart, &c., are mentioned in the Report on Professional Instruction in Germany.

Agricultural apprenticeship.

Provision has already been made to a certain extent to meet the wants of agricultural instruction for young men who intend to become farmers or farm bailiffs; but agricultural apprenticeship for farm servants, and elementary instruction in gardening and arboriculture do not yet exist in France, except in a very few farms. They flourish, however, in these establishments, and in those which the Christian Brothers have founded at Clermont-Ferrand, Igny, Issy, and elsewhere. Germany and Switzerland present excellent models for imitation in this department in their numerous agricultural schools, where instruction, taking the primary school as the starting point, is given to young men who intend to be farmers, vine growers, foresters, &c.

Apprentice schools for girls.

The Commission has not confined its labours to the questions connected with the education of apprentices of the male sex, it has likewise devoted much attention to the industrial and commercial education of girls, for whom it is most desirable to facilitate the means of entering those occupations and employments which are best suited for their sex. Full information as to the schools of rural apprenticeship intended to train young girls to become farmer's wives and farm servants, established in Alsace, the orphanages, and work-schools in the department of Calvados, and the weaving schools in West Flanders, has been laid before the Commission, substantiating the advantages to be expected from such institutions. The schools which prepare girls for situations in trade and certain manual occupations, such as engraving, drawing, and industrial painting, sewing, &c., while

at the same time completing their primary and general instruction, as well as their moral and religious teaching, have been most attentively studied. They have supplied an instance of a well directed organization, which, responding to a want felt by society, is developing itself without any aid from the State or from the local authorities.

Education of working men.

The course to be followed, and the different means to be employed to improve and extend the education of working men already engaged in the practice of their trades, have been among the most important objects of the inquiry. The difficulties thrown in the way of this kind of instruction by the almost total absence of primary education, and especially by the general ignorance of the scientific forms of even the simplest reasoning, have been pointed out to the Commission. However, numerous examples tend to show that by combining the study of drawing with the teaching peculiar to the different industries, it is not impossible to obtain happy results. The man who is in the habit of working any given substance often indeed acquires, by a sort of intuition, a sounder and more intimate knowledge of its fundamental properties and mechanical effects than he who has limited his studies to the desk.

The industrial successes of the pupils of the La Martinière School, those of some of the most obscure and least educated attendants of public courses, the example of the practical (*real*) schools of Austria, and of some schools for adults in France, have fixed the attention of the Commission on the utility of special technical classes that might be opened for certain trades in a large number of towns, and for which professors skilled in the practice of the arts to be taught would not be wanting.

Payment or non-payment.

As means of securing regular attendance, the question of payment or non-payment has been discussed from every point of view during the inquiry, and the means of conciliating in some degree the principle of the former with the liberality of the latter has been indicated.

Public courses.

The utility of public courses of lectures opened in the great industrial centres at Paris, or limited, according to localities, within a narrow circle of acquirements appropriate to local wants, has been insisted on by many of the persons best entitled to give an opinion on such points.

Teaching of Drawing.

Among all the branches of instruction which, in different degrees, from the highest to the lowest grade, can contribute to the technical education of either sex, drawing, in all its forms and applications, has been almost unanimously regarded as the one which it is most important to make common.

Museum of Art applied to industry.

As a powerful auxiliary means for this teaching, the formation of collections of models in the great industrial centres, and especially of a museum of industrial art, which has been advocated by the artists of Paris, has been pressed on the attention of the Commission.

Higher technical education.

With regard to technical instruction properly so called, the importance of the highest order of institutions, such as the Paris

Central School of Arts and Manufactures, the polytechnic institutes of Germany, the Schools of Bridges and Roads and of Mines, which admit out-door pupils, has been abundantly manifested by the different reports which have made known their internal organization, their technical divisions, their programmes, and the tests applied to ascertain what the pupils have learned from their studies. Public notoriety and the active part taken by the pupils of the Paris Central School in the progress of our industry and in the development of public works, are proofs too evident for any doubt to remain as to the utility of such establishments, and the great diffusion of them in Germany forbids France to be content with the state of things existing within her borders.

Schools of commerce.

As regards studies purely commercial and the peculiar instruction which they require, the Paris Upper School of Commerce presents a type of a high order, the usefulness of which has been long manifested by its successes, and which may advantageously serve as a model for similar institutions. The special school recently founded by the Chamber of Commerce of the Seine, with a view of educating merchant's clerks and shop assistants, has been attended with an amount of success which must encourage the foundation of similar establishments.

Higher public instruction of the applied sciences.

The vast numbers who attend the public courses of science applied to industry professed at the Conservatory of Arts and Trades, and the assiduity with which they are followed, not only by the studious youth, but also by auditors of every rank and of all countries engaged in trade or teaching, most clearly demonstrates the utility of these courses, in which scientific and technological knowledge is imparted in the most simple manner and with strict accuracy. Being intended to keep the public well informed of all progress, and of every scientific discovery which can in any way affect the arts and industry, these gratuitous courses, always based on the principles of science and on the facts of experience, are from their very nature the most progressive of all given in France. Besides the means of giving these public lectures, the Conservatory possesses numerous and extensive collections, comprising a great diversity of models of machines and apparatus of all kinds. The oral instruction given is therefore complemented by that which may be obtained from a study of the machines themselves and the manner of working them. Its experimental gallery for machinery and its laboratories, by testing inventions and new products, keep the public duly informed of all real improvements effected, and prevents all danger of misconception as to their merits. Similar institutions, but less complete than the one above mentioned, exist on a smaller scale, but still excellent as far as they go, in several of the German States, especially at Berlin, Vienna, Stuttgart, and in Switzerland, at Zürich. But should it be deemed advisable to increase their number, experience suggests the propriety of restricting them to the wants of the local industries.

In stating all these wants and necessities of technical instruction, all the persons invited to give information to the Com-